

2014

Vision Enhancement System

Introduction to Human Computer
Interaction

Group 13

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Definition of Problem

Humans have multiple senses. The five primary ones are: Sight, hearing, touch, smell and taste. Having fully functioning neurons for those senses makes the human body understand and interpret well information around it. What happens if one of those senses is gone or impaired?

It is well known that vision (or sight) is the most significant of the human senses and in our today's world where every bit of information is primarily based on images, videos and basically anything that the human eye can catch, it is a common fact that vision holds the crown of senses.

Unfortunately there are people around us, either for biological reasons or from a mistreat of fortune that cannot take full advantage of what the world has to give them because of impaired sight. Even a person with normal vision can sometimes not be able to drive a car due to misread of signs and labels or bad weather. For a vision impaired person is even harder. An old person with poor sight, due to aging, can't properly have a morning walk without assistance. Simple joys, from driving a car to having a pleasant walk to the park can't be enjoyed.

So in a world like ours, where technology and sciences thrive, we should take advantage and give a little bit of color and joy to the people who need it. Imagine a device, with the proper hardware and software, enabling someone with a high level of myopia or an elderly drive a vehicle and even alert them while walking towards an obstacle.

Considering all the above we want to create a device that will be the eyes of anyone in need, in the physical world.

Review of related work

OptelecFarView



This gadget magnifies text and it can be used in both real time (point and view) and click and save mode. It allows the user to read text magnified. In order to do that, it uses a camera, which is placed on the back.

Main Features:

- Store documents (Document read mode):
The user can take pictures of a document and save them in order to watch them magnified after.
- Zoom – in (Distance viewing mode).
- Real time close – up viewing:
A user can place it in front of a text and read it magnified in real – time.
- Read (Image enhancement)
- It uses a 7.5MP camera
- The lowest magnifying rate is 2X while the highest is 42X
- 4.3 – inch colour TFT widescreen

This is a nice approach with some advantages but with a lot of disadvantages.

Advantages:

- Big screen
- High magnification rate

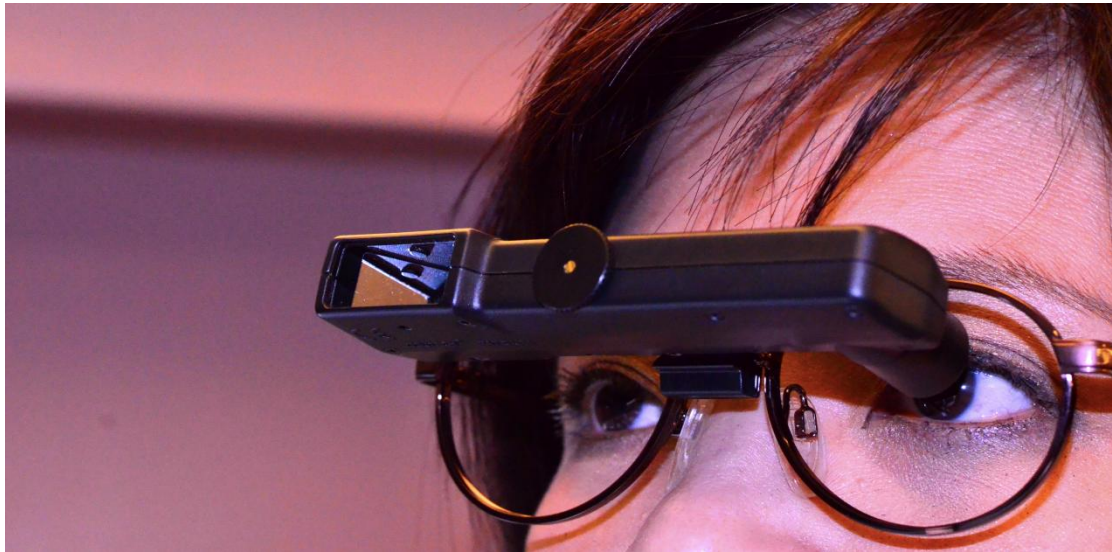
Disadvantages:

- Due to the fact it has a big screen, it is a quite big device.
- Users have to hold the device in order to read or watch.
- The environment is not shown in the interface.
- It is not suitable for driving
- The default magnifying level is 2X

Assuming the disadvantages, this device is good only for using inside a building or when the user is on foot – which is debatable because he / she cannot see the environment. Apart from this, a lot of people want such devices in order to use them while driving. This is definitely not appropriate for driving, first of all the user has to hold the device and it does not show the environment where the user is.

However, it has a big screen, which will help people, especially the older one, to use that. Furthermore, it has a really high rate in magnifying – 42X –, which would really help in driving.

Bioptic Telescopes



This device seems like a miniature telescope, which is mounted within lens. This device is most suitable for those who have not a serious vision problem. The user can watch a magnified image by moving his head, but he has to hold his gaze in the primary position, because this device points in the eyes instead of the whole field of view.

Ocutech VES – Sport is such a device.

Main features:

- Two modes of magnification: 4X and 6X
- It is interchangeable for right and left eye
- Light weight
- It fits to users pair of glasses

Advantages:

- Very simple to use, it just needs an adjustment in the glasses
- The user can walk with that
- It is hands free

Disadvantages:

- It is very simple.

It has no modes. As a consequence, user cannot choose any different option on the way that he will use it.

- The field of view it is very small. The user cannot use it while he is driving because he will not be able to watch the whole environment. Driving wearing such devices was permitted in 39 states of the USA and in the Netherland in 2011.
- According to aesthetic point of view, it is quite strange and weird, so lots of people will not use it.
- It does not implement any technology.

eSight glasses

This device first sold in the US and Canada in October of 2013.

Main features:


- They look like a pair of wraparound sunglasses
- Allows the user to magnify and view objects as close as 12 inches away, having adjustable distance of view.
- Uses a high – resolution camera with zoom capabilities
- The lenses are custom made. The wearer has to provide his medical prescription in order to get the lenses.
- The lenses are covered with a transparent OLED display, which allows users to decide whether they want to fill their whole field of view or the upper portion.
- 14X zoom
- Contrast and colour adjustments

The system uses the camera, which records the environment and a processor, which processes the images, which camera sends frame by frame.

Users have the ability to switch to half screen mode with some magnification or full magnification, or full screen mode.


Analysis of user requirements

Persona 1 - older people

	David Roland Age: 71 Occupation: Retiree (former pilot)	
	BACKGROUND	MAIN POINTS
	Level of Computer Expertise: Comfortable around screens and navigating systems. Although, computer knowledge is not up-to-date. Level of Eyesight: Poor, problem due to farsightedness and blurry vision (age).	Misses driving and flying. Traveling around the world. Wants to be organized and have control of the environment around him. No other health issues or disabilities.
GOALS	DESCRIPTION	
<ul style="list-style-type: none"> Being able to have a “good” image of his environment. Travel again. 	Mr. David Roland is 71 year old man, former pilot who lives with his wife in Glasgow, Scotland.	
PAINS & FRUSTRATIONS	He was a pilot for 37 years when he retired at 60.	
<ul style="list-style-type: none"> Main frustration having poor eyesight which disables traveling around but 	He enjoys walks and he is a fan of independence.	


<p>also some awareness about the surrounding environment.</p> <ul style="list-style-type: none"> Needs a person to help him around even for a walk. 	<p>Although an organized and military character man due to poor eyesight, his environment doesn't fit with his personality.</p>
SENARIOS	USAGE OF SCENARIOS
<p>Mr. Roland:</p> <ul style="list-style-type: none"> Wants to go for a trip to visit his brother. In order to do that he needs to take the train (book a ticket also) and then take a cab. Wakes up in the morning and gets dressed and then makes his morning coffee and takes a walk to the park with his grandchildren and his wife. Is invited to attend at a conference for new and former pilots by his previous airline company. 	<p>Mr. Roland:</p> <ul style="list-style-type: none"> Wears the glasses in the train station to book tickets and detect the information on the screens. The glasses could magnify and detect the information written on the screens and Mr. Roland will easily read and identify his train. He can shut down the system inside the train but when he will get off the train he can use the system to detect the way out / toilets/ arrivals signs etc. Also in the cab to his way to his brother he can wear the glasses to see the signs in the road and be able to tell if they are taking the right way to his brother's house. Also by identifying objects he will be able to tell when the taxi-driver is too close to a car or missed something and inform him. Might want to use the glasses to identify the labels on the canisters like coffee (instead of putting salt or sugar). Most importantly he can use the glasses for his walk to the park with his grandchildren. Through the features of recognition and magnification of the glasses, he will be able to play with his grandchildren avoiding obstacles in the park and therefore avoid injuries. In the park trees, garbage cans even the ball of his grandchildren will be identified from the glasses and Mr. Roland will be able to clearly see them. He will wear the glasses through the conference. He will be able to follow and understand every presentation to the conference due to the glasses features. The glasses will detect each slide's text and chart and magnify them so Mr. Roland will be able to read and clearly see the presentations no matter how far he sits in the conference room. Also he will have no problem presenting his own work and answer questions because of the same features of the glasses.

Persona 2 - Children

	Sarah Johnson Age: 9 Occupation: Student (Primary school)	
	BACKGROUND	MAIN POINTS
	<p>Level of Computer Expertise: Very basic knowledge of how electronic devices work.</p> <p>Level of Eyesight: Poor, birth defect. (Nerve hypoplasia due to Septo-optic dysplasia)</p>	<ul style="list-style-type: none"> • Not able to fully discover the world around her. • Cannot study without help. • Wants to play with other children, without being afraid of injuring herself. • Also suffers from pituitary hypoplasia, which makes her everyday life even harder.
GOALS	DESCRIPTION	
<ul style="list-style-type: none"> • Discover the world and learn more about it. • Being able to read entirely on her own. 	Sarah Johnson is a 9 year old girl that lives with her parents in London, United Kingdom. Sarah was born with Nerve hypoplasia, a rare disorder of early brain development. She enjoys playing hide and seek and wants to make more friends. Unfortunately, due to her poor vision the numbers of activities she can take part in are very limited.	
PAINS & FRUSTRATIONS		
<ul style="list-style-type: none"> • Her main frustration is having poor eyesight, and therefore is sad to not be able to participate in certain activities, unlike other children, without her condition. • Depends on other peoples help to get through everyday life. 		


SENARIOS	USAGE OF SCENARIOS
<p>Sarah:</p> <ul style="list-style-type: none"> • Wakes up in the morning, and gets ready for school by herself. • Plays hide and seek with other children in the playground. • Studies and reads on her own, without her mother's assistance. 	<p>Sarah:</p> <ul style="list-style-type: none"> • She can use the virtual impairment glasses to achieve a better perception of the world that is visible to her and therefore easily distinguish small objects around her, such as a pencil, an eraser etc. As a result she will be able to pack her schoolbag without assistance. • She can successfully play hide and seek with other children in the playground without injuring herself, by once again using the visual impairment glasses capability to better identify the objects around her and find a good hiding spot. • Instead of being aided by her mother with homework via dictation, Sarah can try reading entirely on her own using the zooming capability of the visual impairment glasses, to recognize letters and eventually words more efficiently.

Persona 3 - Young adults (Visually impaired)

	JOHN DOE Age: 32 Occupation: Accountant	
	BACKGROUND	MAIN POINTS
	Level of Computer Expertise: Quite familiar with technology gadgets. Is not interested on how computers and electronics work as long as these devices perform as they are intended to. Level of Eyesight: Sight Impairment due to genetically reasons.	Although not having major problems to move around in his everyday life when detailed sight is needed it is quite challenging for him
GOALS	DESCRIPTION	
Wants to be able to read signs on the road from a greater distance. Be able to move around more comfortably while searching for a specific store or address on his own. Travel again.	John is a young accountant who works in a shipping firm. He enjoys passing time with his friends and travelling. He sometimes feels that his poor vision is an obstacle in order to enjoy some activities. He is not married John enjoys watching movies and plays. John likes to travel and usually visits a foreign country during his summer vacation. To go to his work he takes his car and drives for 20 minutes plus the time it takes him to find as parking spot.	
PAINS & FRUSTRATIONS		
While driving on motorways John is unable to read signs from a distance and misses exits. Searching for a specific street is challenging for him		

<p>because in order to read the street signs he needs to get quite close.</p> <p>During night it is even harder to focus and spot objects in detail.</p>	
<p>SENARIOS</p>	<p>USAGE OF SCENARIOS</p>
<ul style="list-style-type: none"> • Wants to travel by car to Liverpool for a seminar to get informed on the new taxing law but he is going to be driving on his own. He has never driven to Liverpool before and although he has a navigation device, he wants to be able to read signs on the motorway from a longer distance. • Wants to attend the seminar but knows that a lot of people have enrolled and is considerate if he will find a seat on the front rows as he struggles to read slides projected when sitting in the back. 	<ul style="list-style-type: none"> • John wakes up in the morning has a quick shower and gets ready to drive to Liverpool in order to attend the seminar. He gets in his car wears his glasses and starts up the system on Driving mode. • As he drives down the motorway the cars that are in front of him are marked in a red square and so he is able to see all the obstacles and avoid collision. • As he approaches an intersection the signs that inform him which intersection that is are magnified and so he is able to read them at a much greater distance than if he wasn't using the system. • He feels much more confident driving as the system informs him of close by cars that move close to him and he is able to take the right exit towards his destination. • After reaching his destination, John enters the conference room and takes his seat. Even though he is seated towards the back of the room he knows that he will have no problem attending the seminar. He changes the mode on his glasses to Seminar mode and so he is provided of a magnified picture of what is projected on the slides. • John is aware of all the changes of the taxing law as he was able to follow the speaker and the slides projected much more easier than if he was not using the system.

Persona 4 - Young adults (Techies)

	James Tech Age: 25 Occupation: Student (Computer Science)	
	BACKGROUND	MAIN POINTS
	Level of Computer Expertise: Spends most of his time in front of his computer screen or his tablet or his smartphone. Consequently, he is expert in using computers and the majority of technological staff. To sum up, technology is part of his everyday life. Level of Eyesight: Good. Due to his age he does not face sight problems like cataract or farsightedness.	Make his life even easier Wants information about his environment He wants everything that is connected with technology He buys any new technology product
GOALS	DESCRIPTION	
Driving wearing a technology product which will help him understand the signs clearly Perform daily “procedures” easier thanks to technology	James loves technology consequently holds latest technology products. He spends most of his free time in www.engadget.com getting informed for new technology releases. He uses technological products every time. His life is totally connected to technology.	
PAINS & FRUSTRATIONS		
James does not have any special vision difficulty. His level of eyesight is very good at the moment. He wants this type of glasses in order to feel more certain while he is driving.		

SENARIOS	USAGE OF SCENARIOS
<ul style="list-style-type: none"> • Holds every new technological product. He wants this product because is something new in the technology “world”. He will wear this pair of glasses in his course in order to feel unique. • Uses his car a lot. Although, he has a navigator in his car and a GPS application installed on his phone, he wants to feel able to watch the signs on the motorway. Apart from this, because he is always thinking different things, he needs something that it will inform him if he will lose his attention. • Starts studying from his e – book. After two hours, he is having a break because his eyes are tired. 	<ul style="list-style-type: none"> • Wears this pair of glasses and he knows that he holds the latest technology. Now, he feels satisfied because there is nothing that is “ahead” of him. The first time that he went to the university wearing these glasses, everyone started asked him about this new gadget. • While he is driving, he uses this system in order to read the signs on the motorway. Now, he feels more certain while he is driving. This system magnifies the road signs, thus it will be easier for him to find the exit. Apart from this, this system will identify the cars in front of him, so he will have a safer journey. • He is getting bored while he is studying. Apart from that studying for a course or reading a book can become tedious without the appropriate devices. Apart from this, James is a addicted to technology, so studying while he is wearing these glasses will make studying more funny.

First generation prototypes (Low fidelity prototypes)

Prototype 1

This prototype uses the main features of the system which are **obstacle recognition** and **magnification**. With the use of standard optical glasses with lenses with or without optical correction (depending on the user) a device (a processor with a camera attached Figure1.1.) is attached to the glasses and information is displayed in an optical frame (30x18 cm) in a distance from the device at about 50cm. The camera is attached to the right-side of the glasses and takes input from the surrounding environment. According to the users selections (through the interface) the system operates accordingly.

The system will be divided into two main modes, Outdoors & Indoors, with 4 subcategories for each.

If the system is going to be used outside it will have different features in terms of brightness, contrast etc than when it is going to be used inside a room.

For each mode the system will contain 4 different modes:

Outdoors:

- Driving
- Running
- Walking
- Other
-

Indoors:

- Reading
- Lectures
- Cinema
- Other

Some of those modes will have the exact same features and some will have adjustments.

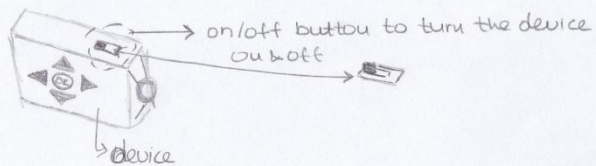
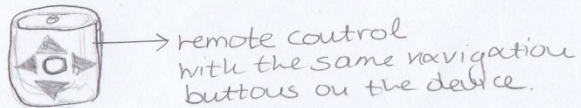
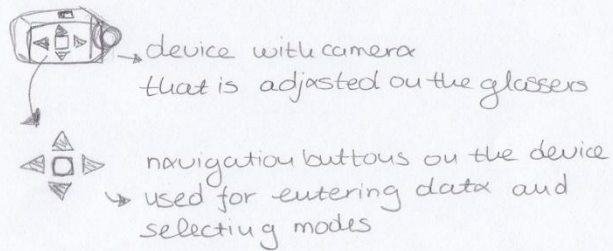
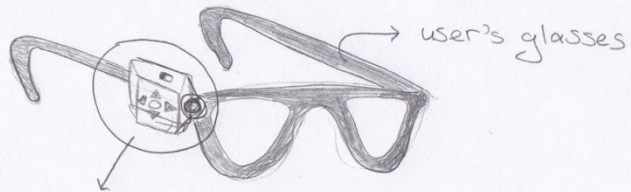
Driving and Running mode will have a slight difference from the other modes, not in terms of interface but in terms of screen resolution, processor speed and performance.

Lectures, Cinema and Reading also share same features like recognition of a large screen from a distance and representation of the screens info on the system's frame. Cinema mode though will have an extra feature of reading and magnifying subtitles only. Reading mode is similar with the subtitle mode in Cinema mode.

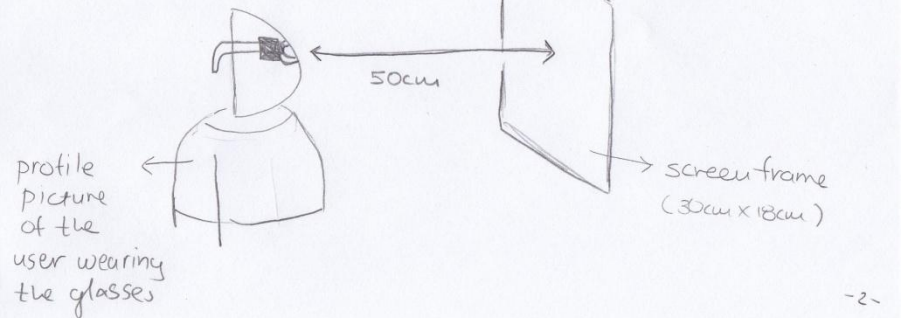
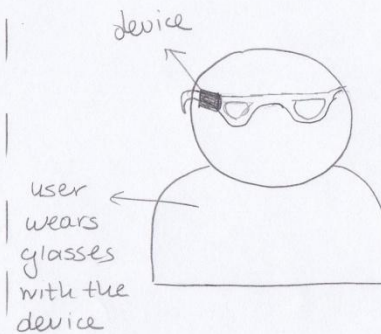
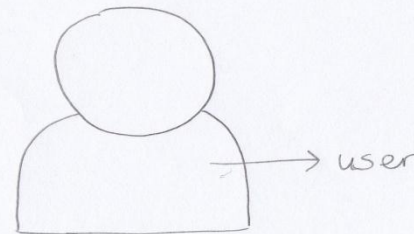
Walking mode, uses the default system (simple recognition and magnification) as well as the Other mode in both Outdoors and Indoors modes.

An example use of the system for each mode is presented in the **Prototype 1** papers.

Prototype 1



User & Glasses



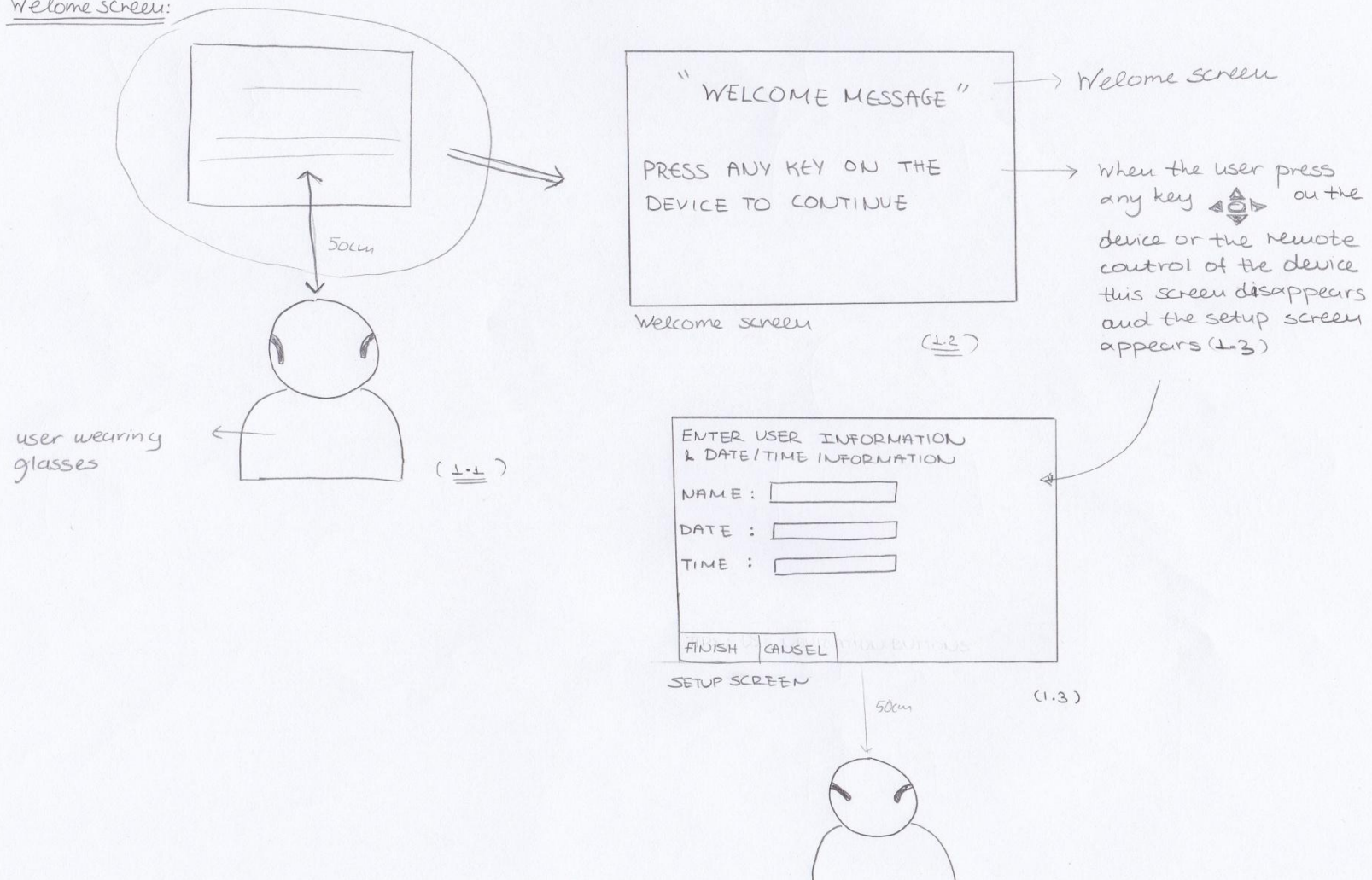
-1-

-2-

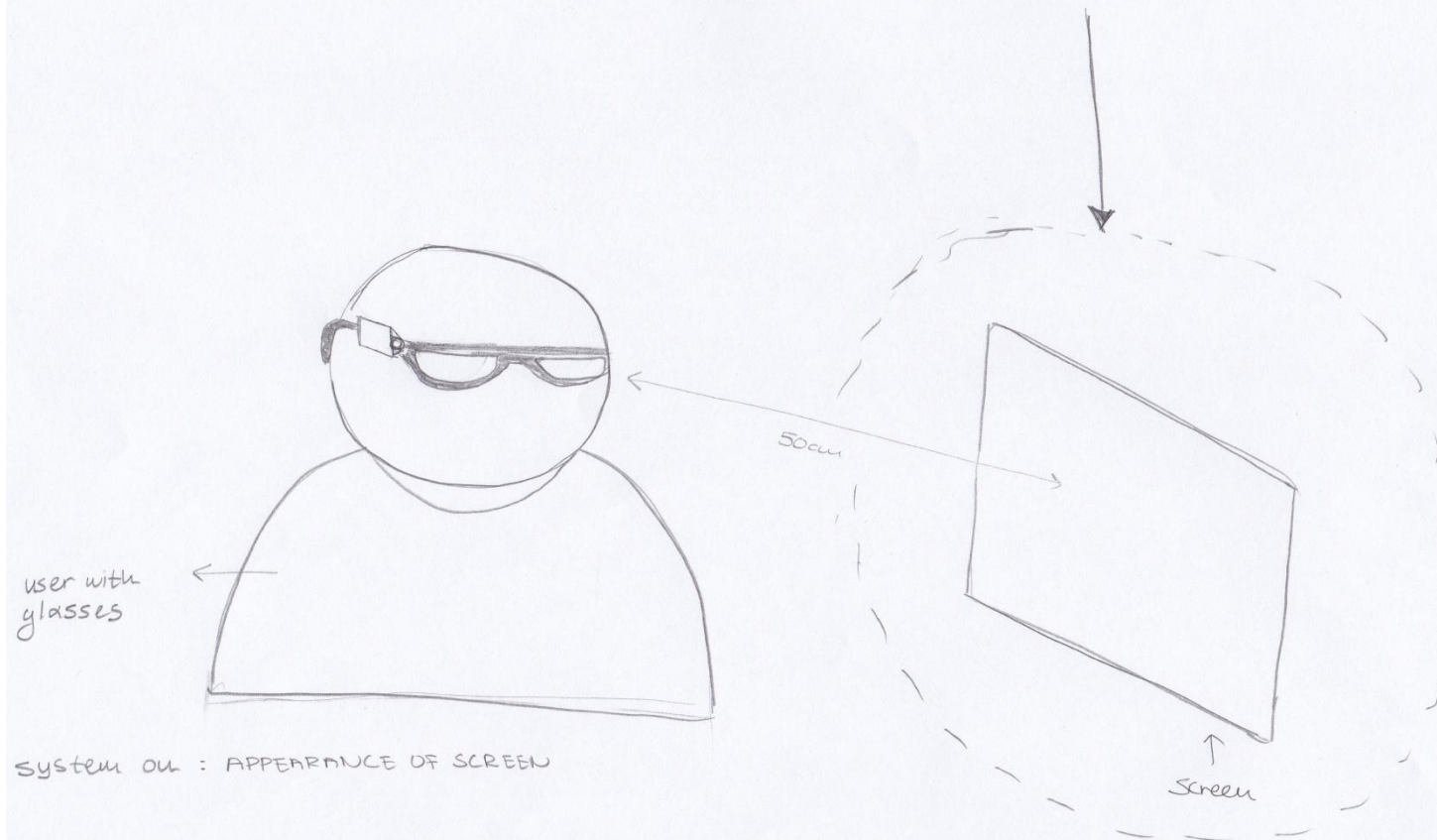
First start-up of the system

-2-

Welcome screen:



FROM NOW ON THE SCREENS THAT FOLLOW REPRESENT WHAT THE USER SEES IN THE
SCREEN FRAME! ▼



System on : APPEARANCE OF SCREEN

WHAT THE USER SEES ON THE SCREEN FRAME (INFORMATION DISPLAY)

-4-

SETUP SCREENS:

ENTER USER INFORMATION
↳ DATE/TIME

NAME :

DATE :

TIME :

TIP : USE NAVIGATION BUTTONS

FINISH CANCEL

SCREEN 1

USER CLICKS ON THE NAVIGATION BUTTONS

NAME : WHEN THE CURSOR APPEARS
THE USER SHOULD CLICK THE
OK BUTTON

DATE :

TIME :

ENTER USER INFORMATION ↳ DATE/TIME

NAME :

QWERTYUIOP
ASDFGHJKL
ZXCVBNM

0 1 2 3 4 5 6 7 8 9

TIP: USE THE TO CHOOSE LETTER AND THEN
CLICK OK

SCREEN 2

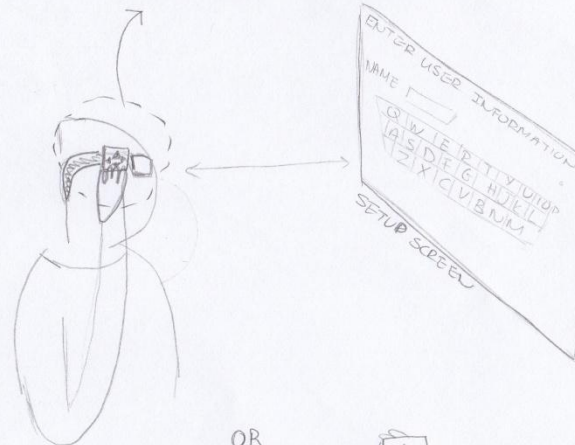
NOTE : LIKEWISE FOR DATE & TIME

SETUP SCREEN APPEARS ONLY THE FIRST TIME USER USES THE SYSTEM

BUTTONS ON SCREEN: FINISH CANCEL

- WHEN **CANCEL** BUTTON SELECTED THE SYSTEM GOES BACK TO THE WELCOME SCREEN (1.2)
- WHEN **FINISH** BUTTON SELECTED THE SCREEN 3 APPEARS (PAGE -5-)

USER USES THE BUTTONS ON THE DEVICE TO ENTER THE INFORMATION.



OR

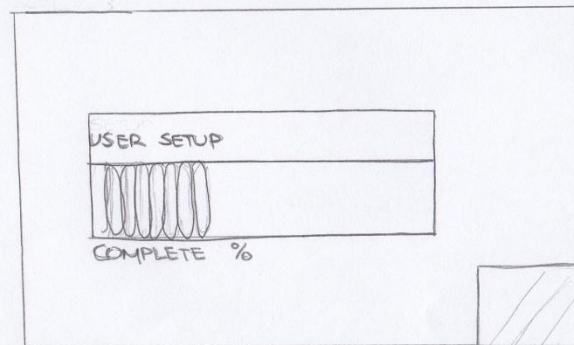
the remote control



- Prototype 1 -

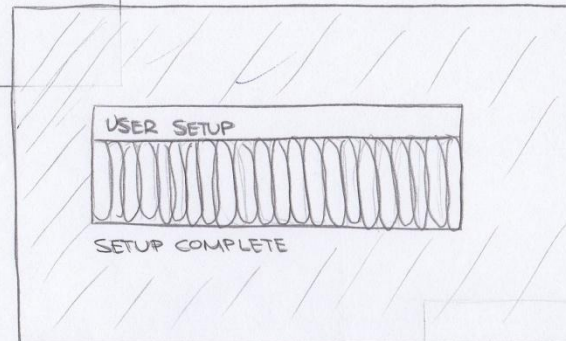
-5-

AFTER FILLING ALL THE INFORMATION SELECT "FINISH" BUTTON
THE FOLLOWING SCREEN APPEARS:



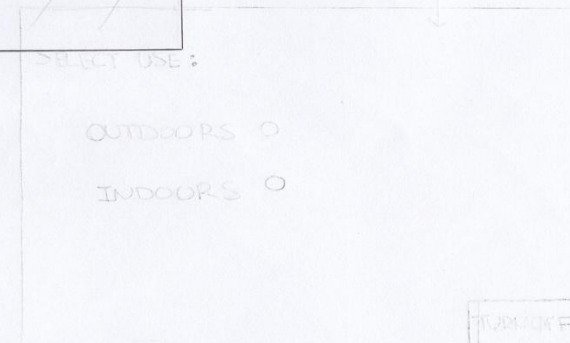
SCREEN 3

when the SETUP
is complete (SCREEN 4)
it will automatically
direct you to the main
screen.



SCREEN 4

THIS SCREEN APPEARS
AUTOMATICALLY WHEN THE
SETUP IS COMPLETE



MAIN SCREEN

AFTER THE SETUP COMPLETION AUTOMATICALLY
APPEARS THE MAIN SCREEN

USER: "USER'S NAME" 01/11/2014

SELECT USE :

OUTDOORS ☐

INDOORS ☐

TURN OFF

MAIN SCREEN

BUTTON : TURN OFF

WHEN TURN OFF IS SELECTED
THE SHUT DOWN SCREEN APPEARS.

GOODBYE USER "USER'S NAME"

SYSTEM SHUTS DOWN

...

SHUT DOWN SCREEN

USING THE NAVIGATION BUTTONS USER CAN CHOOSE EITHER OUTDOORS USE OR INDOORS USE AND

OUTDOORS CHOICE

USER: "USER'S NAME" 01/11/2014

SELECT USE :

OUTDOORS ☒

INDOORS ☐

SELECT TURN OFF

- THE ● (filled bullet) means that this option will be selected
- THE ○ (not-filled bullet) means that this option will not be selected
- NOTE: YOU CAN'T CHOOSE BOTH!
- AFTER THE CHOICE (●) click SELECT

INDOORS CHOICE

USER: "USER'S NAME" 01/11/2014

SELECT USE :

OUTDOORS ☐

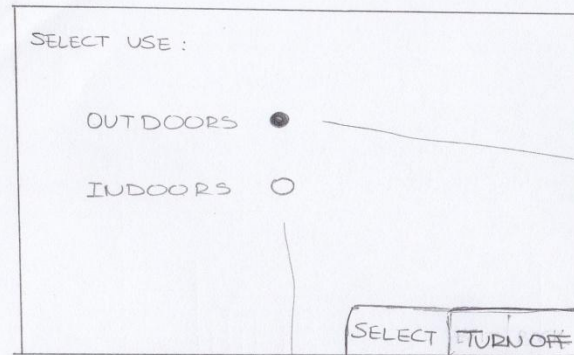
INDOORS ☒

SELECT TURN OFF

- TURN OFF BUTTON GETS YOU TO THE SHUT DOWN SCREEN

- Prototype 1 -

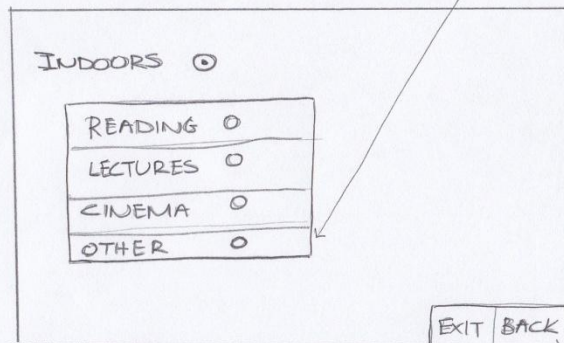
-7-



MAIN SCREEN 2

IF INDOORS
WAS SELECTED

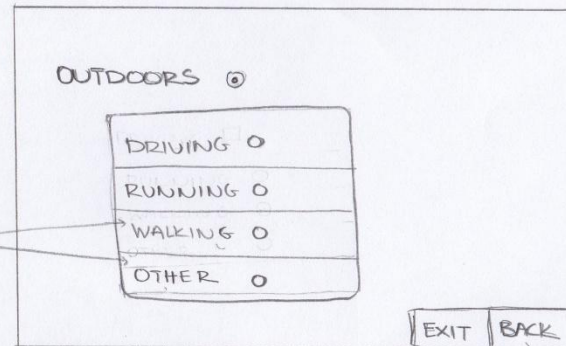
WALKING & OTHER
USE THE STANDARD SYSTEM
DEFAULT ANALYSIS



INDOORS SCREEN

IF SELECTED GOES BACK
TO THE PREVIOUS SCREEN
(MAIN SCREEN)

OUTDOORS SELECTED



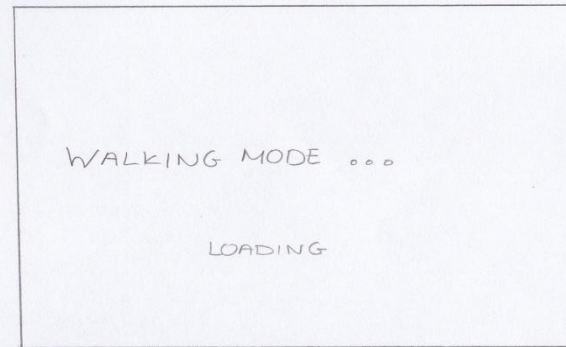
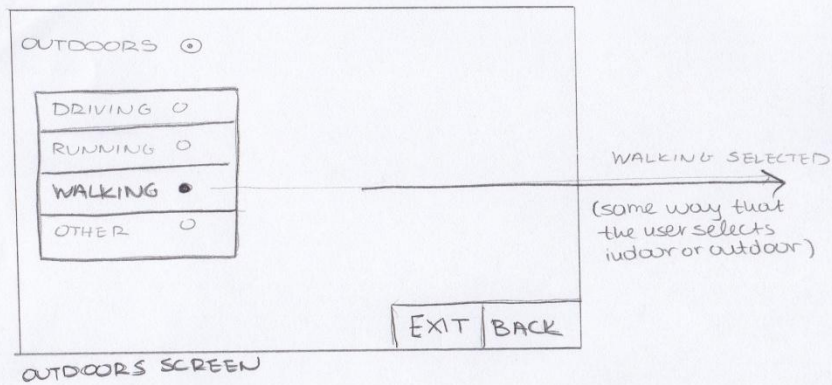
OUTDOORS SCREEN

IF SELECT GOES
TO THE PREVIOUS
SCREEN
(MAIN SCREEN)

NOTE: OUTDOORS SELECTIONS DRIVING AND RUNNING
DO NOT HAVE DIFFERENT INTERFACE ONLY
ADJUSTMENTS IN THE RESOLUTION AND PROCESSOR
SPEED AND RESPONSE TIME.

-Prototype 1-
OUTDOORS SELECTION:

-8-



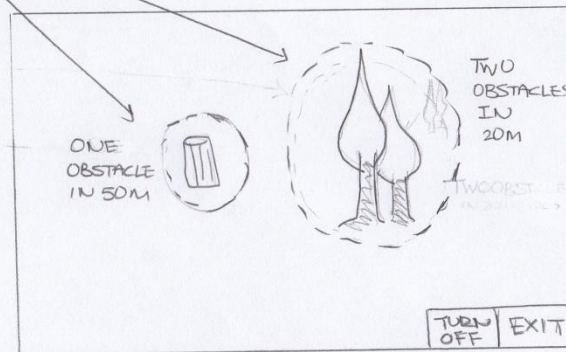
NOTE :
SAME LOADING
PAGE APPEARS
FOR BOTH
OUTDOOR OR
INDOOR MODE

WALKING MODE



RECOGNISES OBSTACLES
IN USER'S VISUAL FIELD

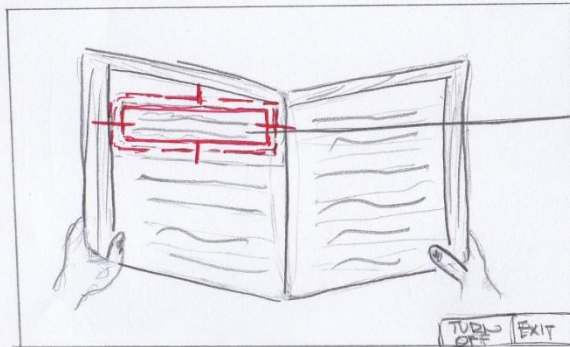
Turns OFF
OBSTACLE RECOGNITION



INDOORS SELECTION

- Prototype 1 -

READING MODE



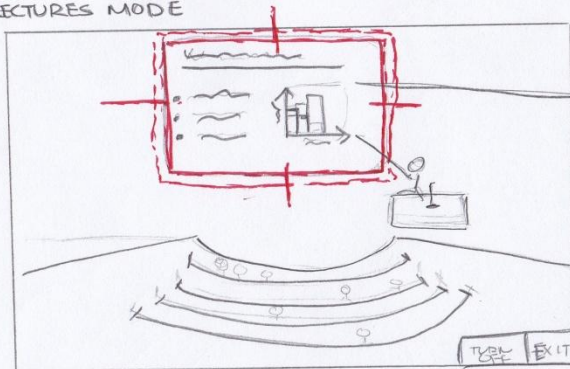
READING MODE - SCREEN ONE

SYSTEM IDENTIFIES
'LINES (TWO)
FROM THE BOOK
AND MAGNIFIES
THEM



READING MODE - SCREEN TWO

LECTURES MODE

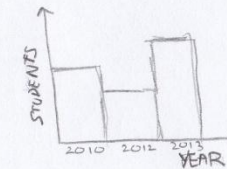


LECTURES MODE - SCREEN ONE

the system
detects the lecture's
screen
and presents
the current slide

INTRO: LECTURE 2

- Representation of a chart
- Identify chart type
- Identify titles



LECTURES MODE - SCREEN TWO

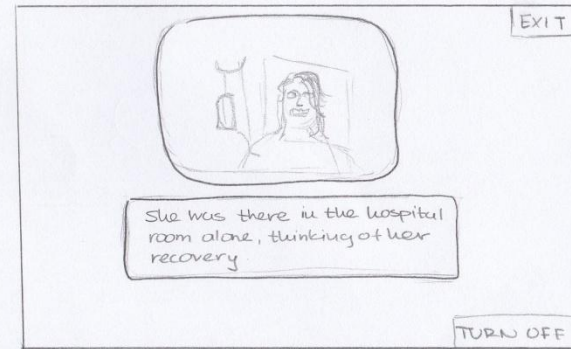
-Prototype 1-
CINEMA MODE

-10-



CINEMA MODE - SCREEN ONE

IF SUBTITLES MODE
IS SELECTED

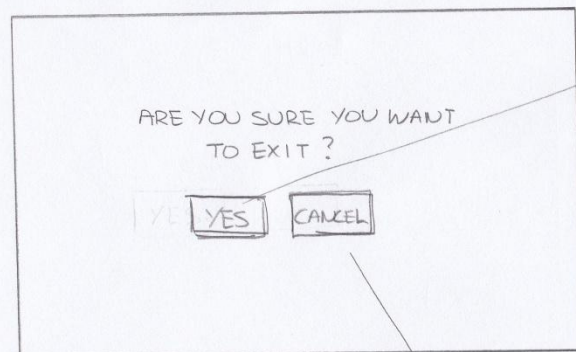


CINEMA MODE - SCREEN TWO

KEEPS THE CINEMA
SCREEN THE
WAY IT IS
AND JUST
MAGNIFY THE
SUBTITLES

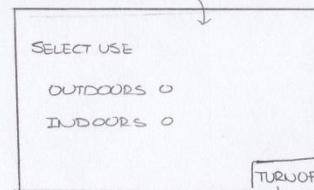
NOTE: WITHOUT THE SUBTITLES MODE THE CINEMA MODE FUNCTIONS AS THE LECTURE MODE.

• IF THE EXIT BUTTON IS SELECTED AT ANY MODE EXIT

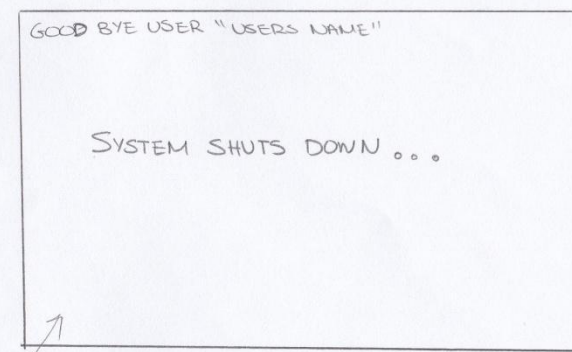


EXIT SCREEN

YES BUTTON SELECTED
TAKES YOU BACK TO
MAIN SCREEN



TURN OFF
SELECTED



TURN OFF SCREEN

CANCEL RETURNS
TO THE PREVIOUS SCREEN

Evaluation & Assessment – Prototype 1

Personas Usage

Older people

In general older people don't feel comfortable using and "wearing" something this futuristic. Also inputting information in the system might be a challenge for them.

Also the fact that a screen will appear in a distance of 50cm might be confusing especially if they don't have any computer experience.

Persona – David Roland

Scenarios Evaluation

- **Train trip and cab to his brother**

Mr. Roland at first was confused because he chose Indoor Mode but could not find the write chose for him. Finally he chose other mode (which is the same as walking mode). He was able to use the glasses to the train station to spot the signs. That made it easier for him to find his platform and read the instructions for the first time without a problem of being too far to read them or because of his vision.

Problems appeared in the cab where he switched to Driving Mode. Because of the size of the screen and that it appears 50cm from the glasses made it confusing, destructing and dangerous inside the car. The cab driver was distracted even though Mr. Roland was sitting next to him and also Mr. Roland was not satisfied not because the system didn't do what it was suppose to do but because it was not ergonomic.

- **Everyday activities / Walk to the park**

He was confused what mode to choose inside the house. He chose indoor/other mode again. The glasses really helped him when he was outside of the house. He used Outdoors / Walking Mode. He was able to identify obstacles and not pump into them. In the park he could play with his grandchildren.

- **Conference**

Mr. Roland went to the conference and chose Indoors / Lecture Mode. He was able to observe and follow the presentations without a problem due to the glasses features. He was able to see the charts and read the text on the slides.

Observations and Conclusions

Mr. Roland has an experience with complicated systems and navigating systems because of his work experience. He doesn't find it that difficult to use. The remote control helped him a lot to navigate around the system. He spent quite some time though to understand how to input his personal information.

He liked the fact that the system was working with modes Outdoors/Indoors and then sub-modes. It helped him make the right choice. Although he didn't quite understand the differences within the modes because there were no explanations. Also the Other Mode confused him because it didn't do anything different than the walking mode.

Through the modes Mr. Roland took about 3 hours to feel comfortable around the system and get used to the screen and the features that the system provides.

Reading Mode & Driving Mode got a really negative reaction from Mr. Roland because he could see the book but the screen appeared a few centimeters behind the book and it was really confusing. In Driving Mode (Mr. Roland was in the passenger's sit) seeing an image in front of him while in the car was really distracting than helpful and to add to that it was distracting for the driver next to him as well.

Mr. Roland enjoyed the use of Lecture Mode and Cinema Mode saying that it was really helpful and he could even read with ease the subtitles, texts, charts and slides. Also he is fond of the Walking Mode because it provided him extra caution while in the park etc.

Children

Due to the bulk of the system and the fact that children are very active in their everyday tasks it is not the most suitable product to be used by them.

Generally using the system and inputting information will certainly not be a problem for children as most technology products are quite intuitive for them.

Persona - Sarah Johnson

Scenarios Evaluation

- **Everyday Activities**

Sarah didn't find a mode that suited her. Walking and other mode for indoors just confused her because she could see only the things that were magnified.

- **Playing**

Sarah use to the Running mode but still didn't made any difference. Moreover glasses keep fall from her face.

- **Doing homework**

Reading Mode didn't work out for Sarah because the image was behind of her books.

Observations and Conclusions

Due to Sarah's visual impairment problem which is quite serious the glasses weren't able to solve the problem but it made some difference and helped Sarah.

Sarah took 7 hours to get used to the glasses but only because of her poor vision. Nevertheless she had no problem finding her way through the system, even entering her personal details etc. Also she figured out that even though there aren't any buttons to select when she was done filling her information she just pressed the OK (central button) on the glasses.

At that point she mentioned that the remote control wasn't useful to her and that she find it more easy to use the buttons on the glasses.

Due to her young age she was pretty forward and told us that the “Other mode” was useless and also she is too young to drive so she didn’t need a Driving Mode as well.

Reading Mode didn’t work out for Sarah because the image was behind of her books. Sarah need a device that magnifies everything around her as she needs to read and write. Lecture mode is obviously not for her as she need to write in her textbooks.

Running and playing with the glasses and the system on didn’t make a good impression to Sarah because the system device on her glasses made her glasses shift and sometimes fall off her face.

Young people visually challenged

Generally this class of users is most probable to be using the device with almost no problem. Inputting information to the system will most certainly not be an issue for them.

Persona – John Doe

Scenarios Evaluation

- **Driving**

Problems appeared while Mr. Doe switched to Outdoors / Driving Mode. Because of the size of the screen and that it appears 50cm from the glasses made it confusing, destructing and dangerous while driving. Within 7min in driving mode Mr. Doe pulled the car from the road and switched of the device.

- **Seminar**

Mr. Doe switched to Lecture Mode for the seminar he had to attend. No problems there, he could easily see the text and the screen.

Observations and Conclusions

Mr. Doe had no problem of familiarity with the system because he works with computers in a daily basis. It took him 2 hours to work through all the system's features.

He said that although the remote control is easier to use for navigation he preferred the glasses buttons because it is easier to forget somewhere the remote control and also it will need batteries and charging which is time-consuming especially in time of need.

He liked the fact that the system was working with modes Outdoors/Indoors and then sub-modes. He would prefer the Modes to be more explanatory but he understood what each is for except Other Mode.

Reading Mode & Driving Mode got negative points from Mr. Doe. In Reading Mode he could see the book but the screen appeared a few centimeters behind the book. In Driving Mode seeing an image in front of him while driving was really distracting and confusing. He was really disappointed because Driving Mode for him was the most essential.

Mr. Doe liked the way Lecture Mode and Cinema Mode were operating.

Mr. Doe was indifferent for Walking and Running Mode.

Techies

This is not the primary target group of the system but techies are always interested in new technology gadgets.

Most surely they will have no problem going through a new innovating system like this one.

Persona - James Tech

Scenario for Mr. Tech is that he just wants the new technology.

Observations and Conclusions

Mr. Tech understood the system within 45 minutes.

He would prefer the screen not to appear in a 50cm distance in front of him but on his glasses. Also he found the use of a remote control old fashioned.

Also he mentioned that the system is user friendly but need more explanations and options to manage the colors, brightness and contrast of the screen.

He didn't like the fact that other mode was no different than the walking mode and he was disappointed because he thought it was a more extreme feature.

Last but not least the Driving Mode was distracting for him due to the screen. He mentioned though that the interface was great nevertheless.

Evaluation method used: Nielsen's Heuristics

1. Visibility of system status
2. Match between system & real world
3. User control and freedom
4. Consistency & Standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility & Efficiency of use
8. Minimalistic design
9. Help error recovery
10. Help & Documentation

Evaluation rates:

- 0 – don't agree that this is a usability problem
- 1 – cosmetic problem
- 2 – minor usability problem
- 3 – major usability problem; important to fix
- 4 – usability catastrophe; imperative to fix

	SEVERITY	WAYS TO IMPROVE
Visibility of system status		
During setup first user login the user is informed of the setup process and can see the completion of his setup. Also we can see the modes loading. Of course the user is not informed of the time needed to load but an average time lower than 5sec is expected.	0	No change needed.
Match between system and real world		
In general the user can understand the system but on the setup screen there is no clear explanation of how to fill the form. Also it isn't clear how the user will navigate on the system (even though the user can see the buttons on the processor and the remote control).	1	Help tips should be provided to help the user learn the system and navigate around it.
User control and freedom		
The system is not that complicated but allows the user to move freely around it. (EXIT, BACK, TURN ON-OFF BUTTONS). The only problem is with the setup screen where if you make a mistake and press CANCEL all the information entered are lost and once you have entered FINISH there is no turning back.	1	There could be a save button but that is not that necessary.

Also no Command Buttons or anything else to click when you complete the user information (Setup Screens – Screen2)	3	Command buttons for completion should be inputted otherwise the system is not functional.
Consistency and standards		
While on the SETUP –Screen 1 the command buttons are on the lower left corner on the next screens the buttons are all on the right lower corner.	2	Buttons should be moved to the right lower corner in order the system to be more ergonomic and not confuse the user.
Also on the Outdoors & Indoors screen the buttons are: EXIT, BACK but when you enter a mode the exit button is on the Right Side.	2	EXIT button should be at be in the Right Side for reasons of usability.
While all the mode screens are consistent with TURN OFF, EXIT on the right corner on the Cinema mode-Screen 2 the exit appears on the right top corner.	2	EXIT button should be moved to the right lower for reason of usability.
Error prevention		
The system is not error prompt by the user. The only error he can do is use symbols or spell wrong his name.	0	No change needed.
Recognition rather than recall		
The only thing the user has to type are his information, so that minimizes load on user's memory.	0	No change needed.
Flexibility and efficiency of use		
The user should be able to play with brightness, contrast, screen colors etc to see what fits to his need, rather than the standard uses of the system (no reference on the prototype for those).	1	Give some options to the user, about screen color etc. (Note: That's not essential)
Also in Reading mode the fact that the information appear on a screen frame in a 50cm distance where the book can be in a 30cm distance from the glasses is confusing.	3	Either the distance of the screen should be adjusted when we enter reading mode or Reading mode is going to be dropped from the system, or this kind of system won't be chosen.

In Driving mode the fact that the information appear on a screen frame in a 50cm distance it is confusing and distracting.	3	Either the distance of the screen should be adjusted when we enter reading mode or Driving mode is going to be dropped from the system, or this kind of system won't be chosen.
Aesthetic and minimalistic design		
The system's design is simple.	0	Nothing to change
Help error recovery		
No error messages, although the system should be configured to show error messages for other than user errors.	3	Error recovery should be figured out in case that the system crashes or the batter don't charge etc.
Help and documentation		
The system is not complex so just help tips or a help button should be provided.	1	Because the system is not complex

General Observations and Conclusions

for Personas

For all personas and with all the Scenarios it seemed that people around them were irritated by the fact that a screen appeared somewhere next to them and it was distracting.

Also Reading Mode and Driving Mode are the 2 features that need to be configured right away.

For children and especially people with very poor eyesight and serious problems this device is not suitable.

For Heuristics

Better arrange of the buttons if possible. Also help tips should be provided to help the user learn the system and navigate around it. Not a good evaluation of errors so system should be configured to tackle with unexpected not user errors.

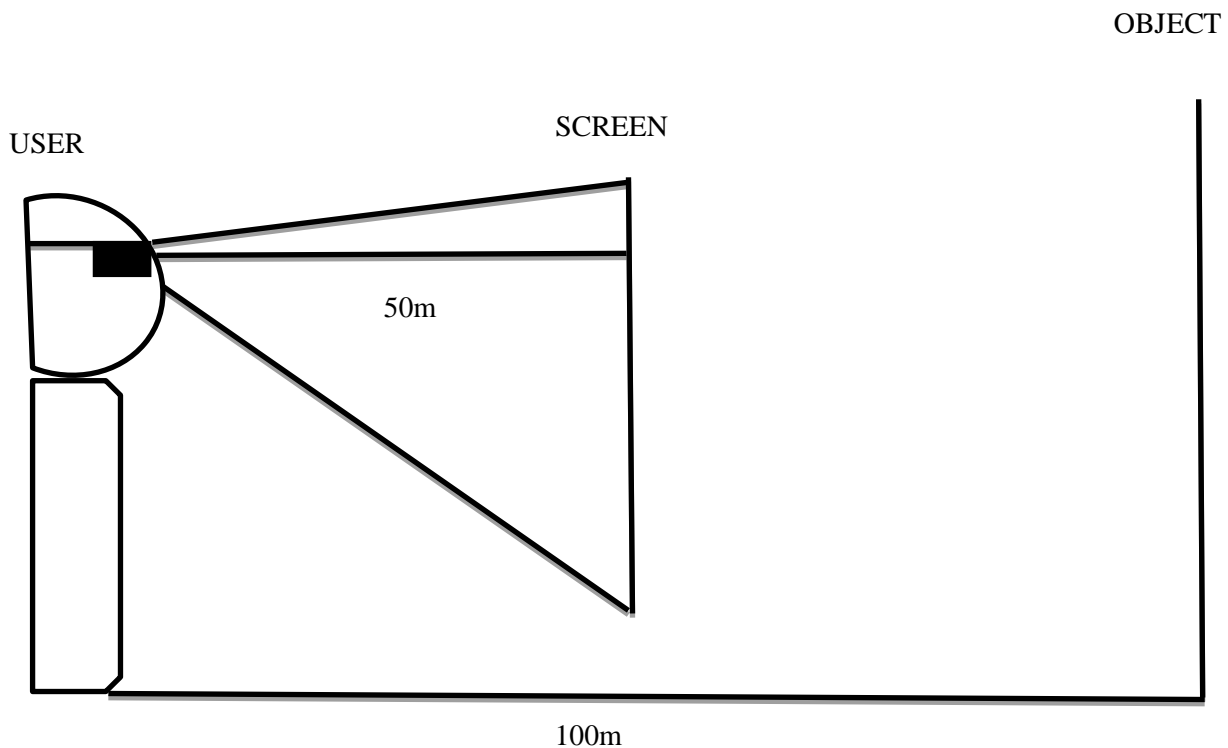
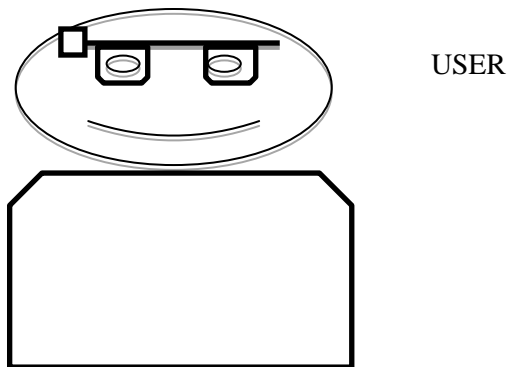
The remote control was only useful to the older people group.

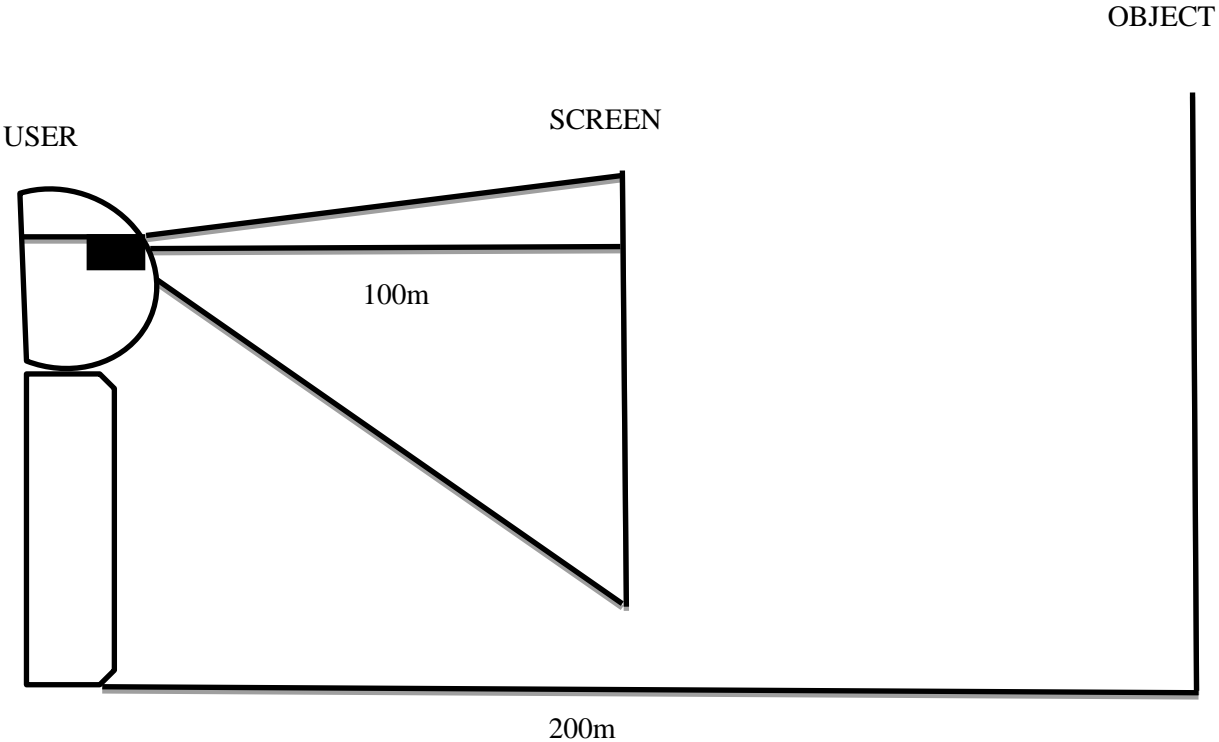
The biggest problem of the system is in the Reading Mode and Driving Mode. The screen frame appears in a 50cm distance while the book it would probably be in a shorter distance. System should be configured to calculate the distance and make the necessary changes to the screen frame.

To conclude we need a better system in terms of distance of the screen. Reading mode cannot be fixed. Because an essential part of the requirements the system should be configured.

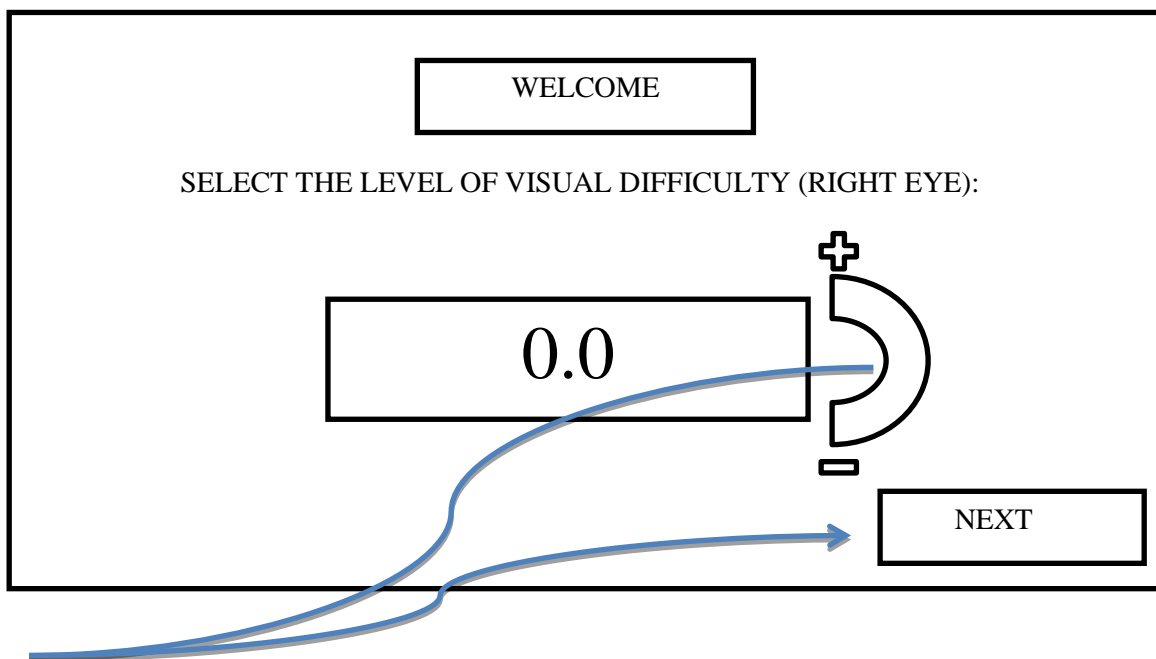
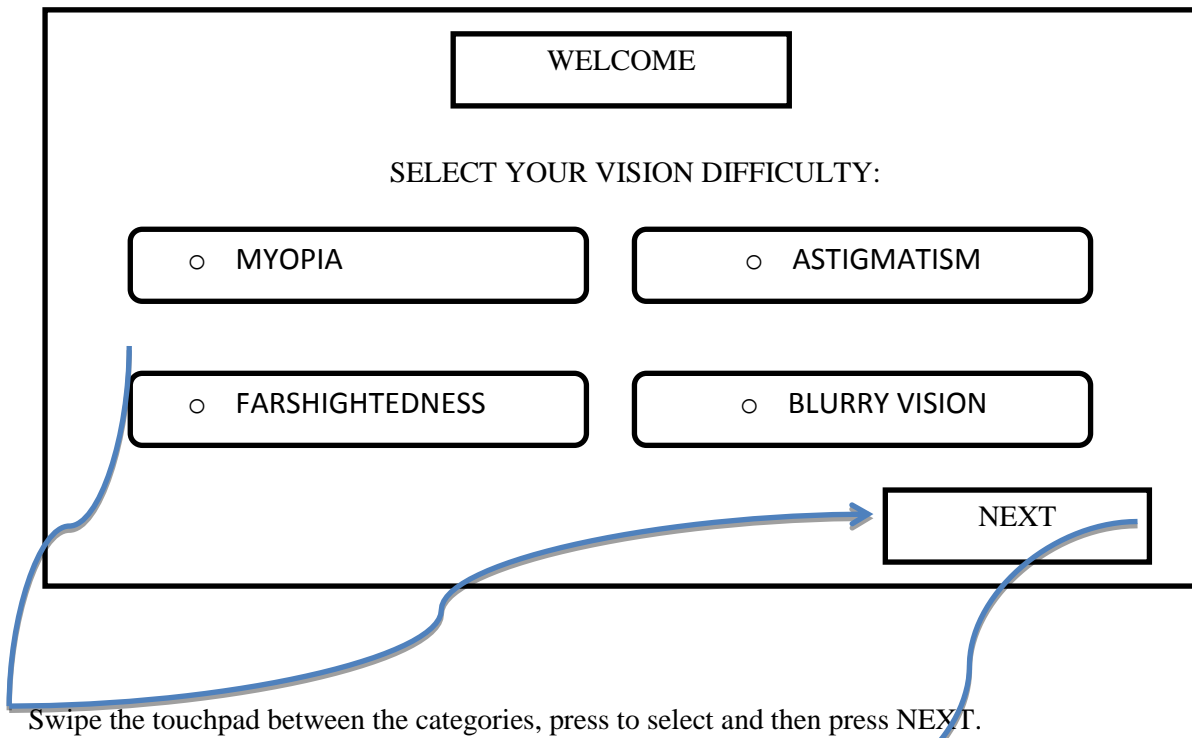
Prototype 2

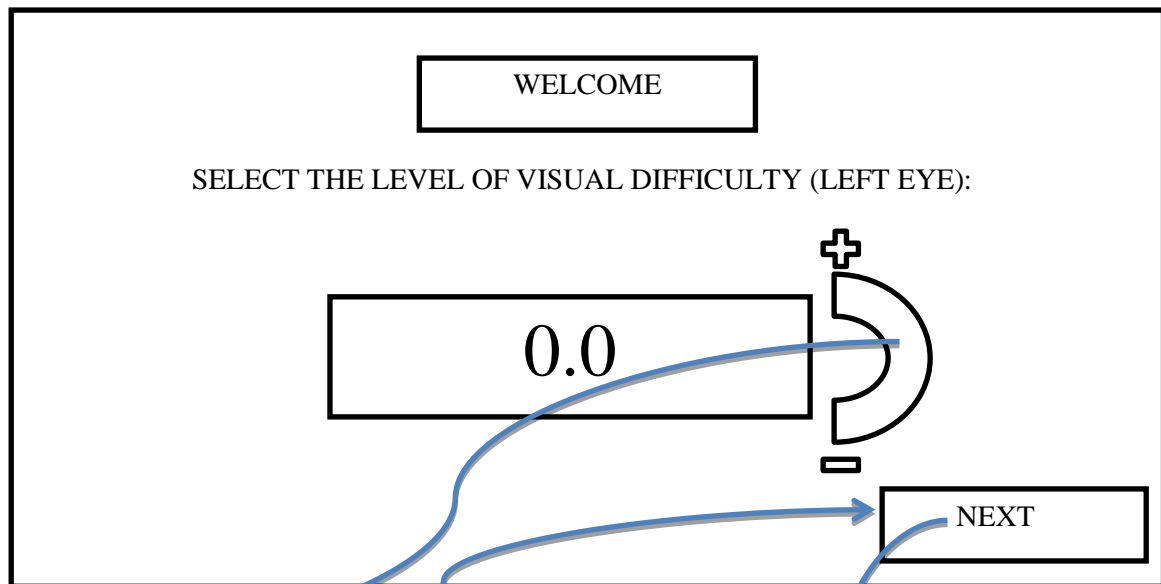
People need to watch information about the objects situated in their environment. These information can be displayed according to horizon. So, it will be easier for the user to watch these information and identify the objects, because these information will not be displayed in front of their eyes. Furthermore, the display distance will not be fixed, but it will be changed dynamically depending on the distance of the first object. As a consequence, users will have the ability to identify the distance of the object too.



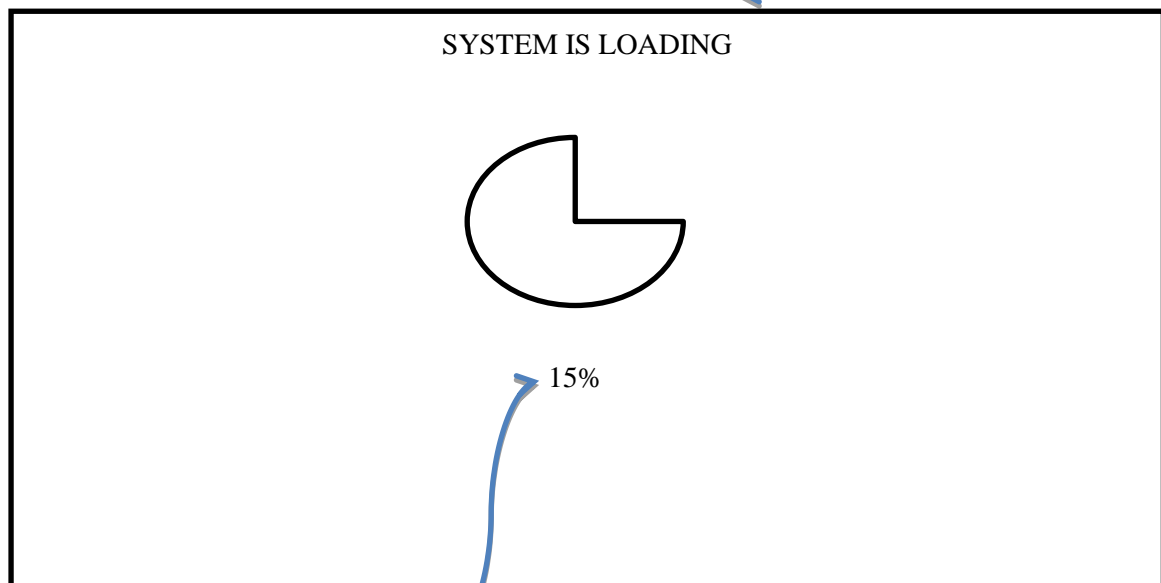


FIRST POWER ON





Swipe the touchpad up to increase or down to decrease, press to select and then press NEXT



Wait until the system loads

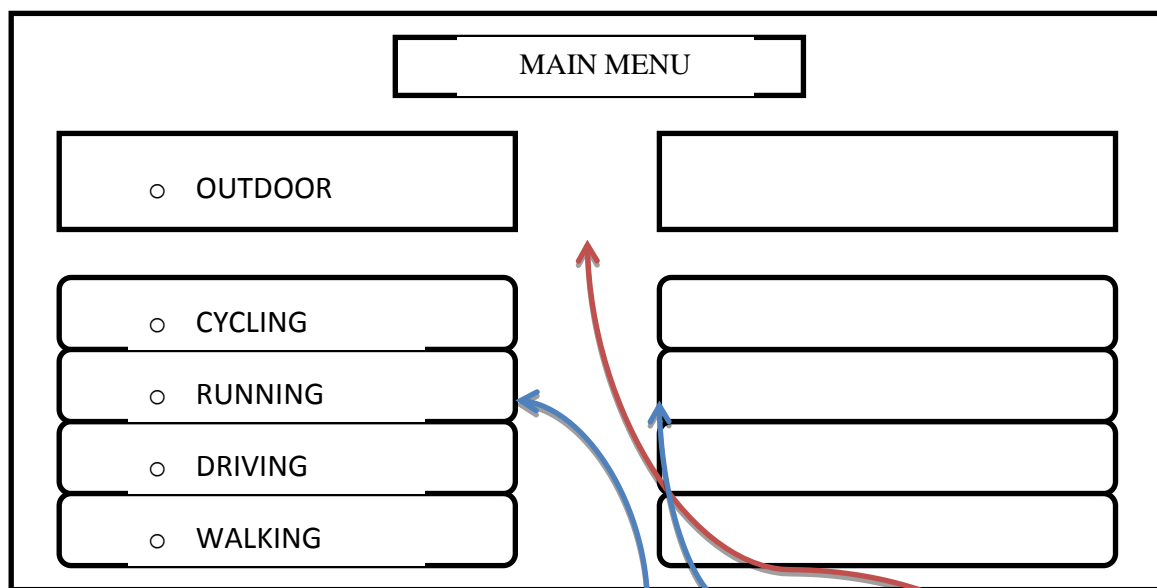
MAIN MENU

After the system loads the main menu is shown in order to choose what you want. The main options are:

1. Outdoor
2. Indoor

Every main option has sub – options:

1. Outdoor:
 - a. Driving
 - b. Cycling
 - c. Running
 - d. Walking
2. Indoor:
 - a. Reading
 - b. Lecture
 - c. Cinema
 - d. Watching TV



Swipe touchpad left or right to choose between OUTDOOR or INDOOR.

Press touchpad to select.

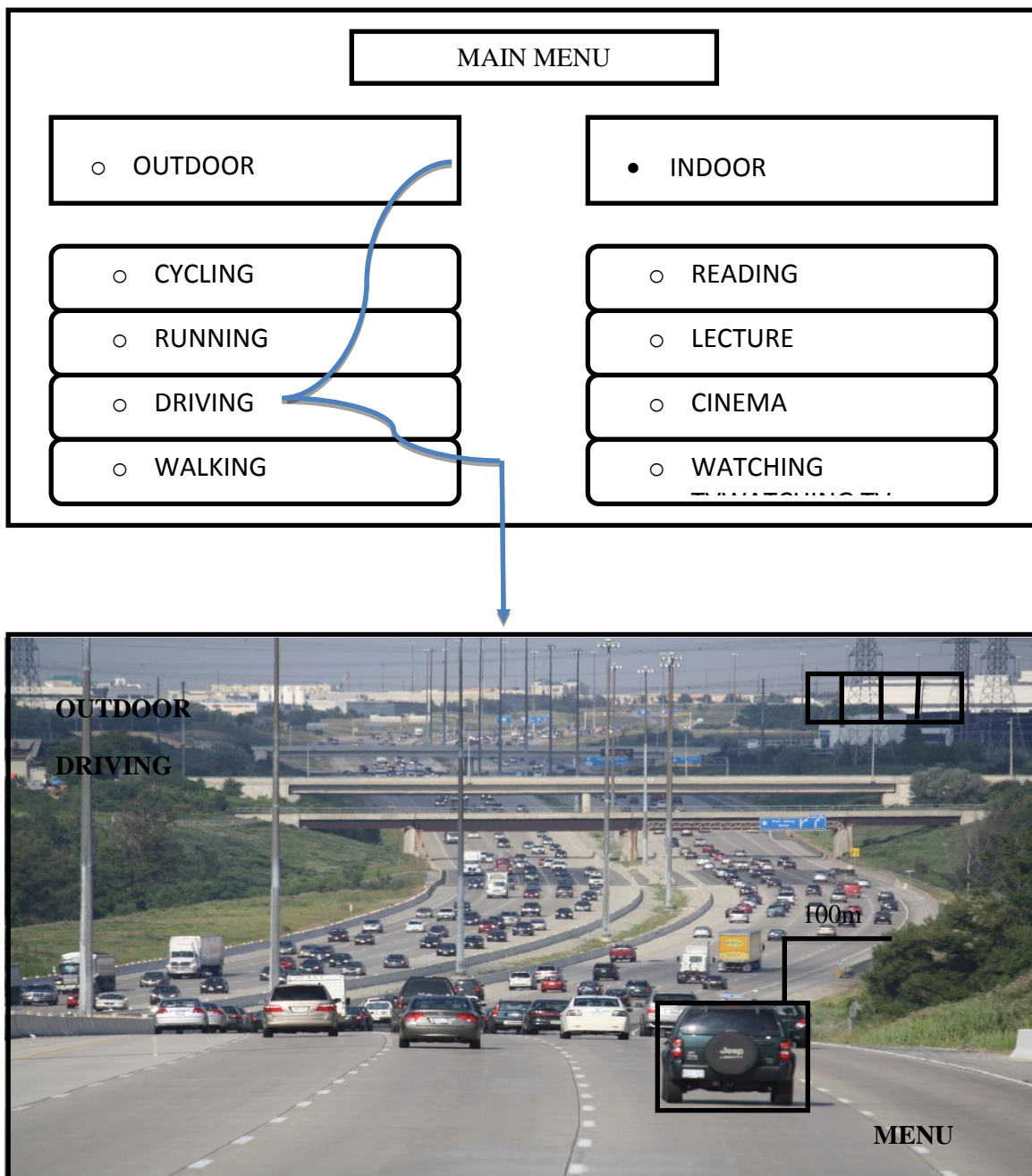
Swipe up or down to navigate through the sub – options.

Press touchpad to select.

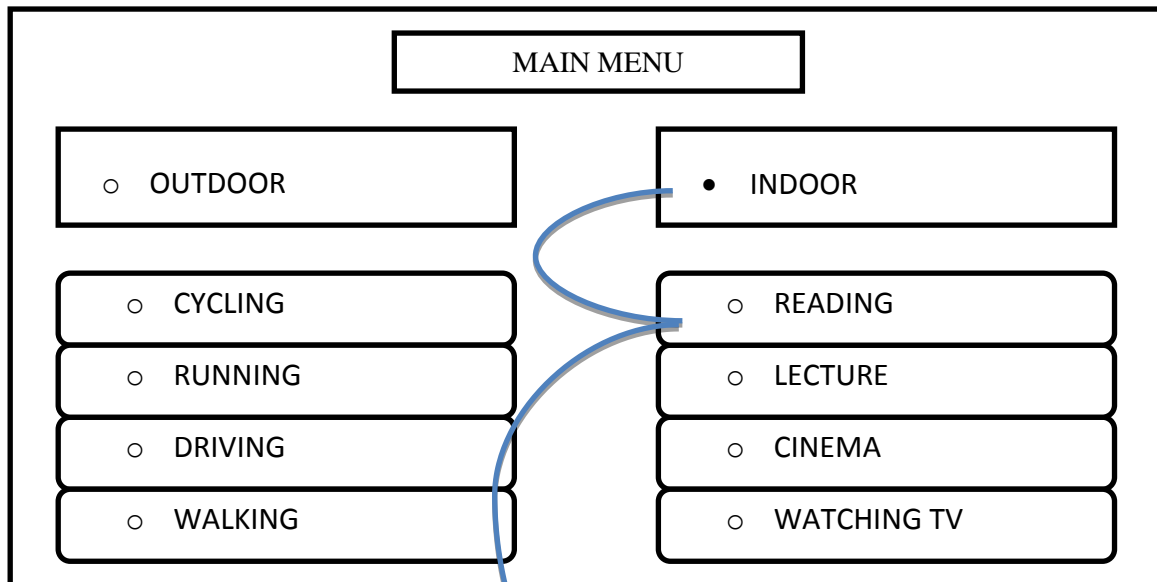
INTERFACE

When user selects the option (Outdoor or indoor) and the sub – option then the screen takes the corresponding view. While selecting the option the bullet next to the outdoor / indoor will get filled.

Assuming that the user has chosen the outdoor – driving mode the main menu will be like this:



In rest outdoor sub – options the interface will be the same.

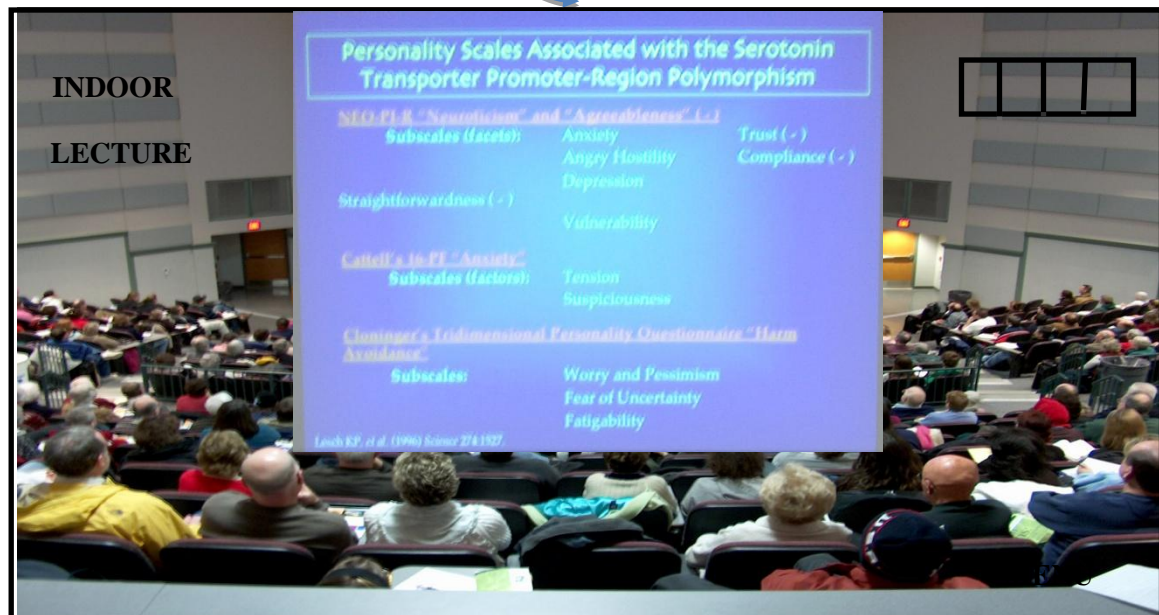
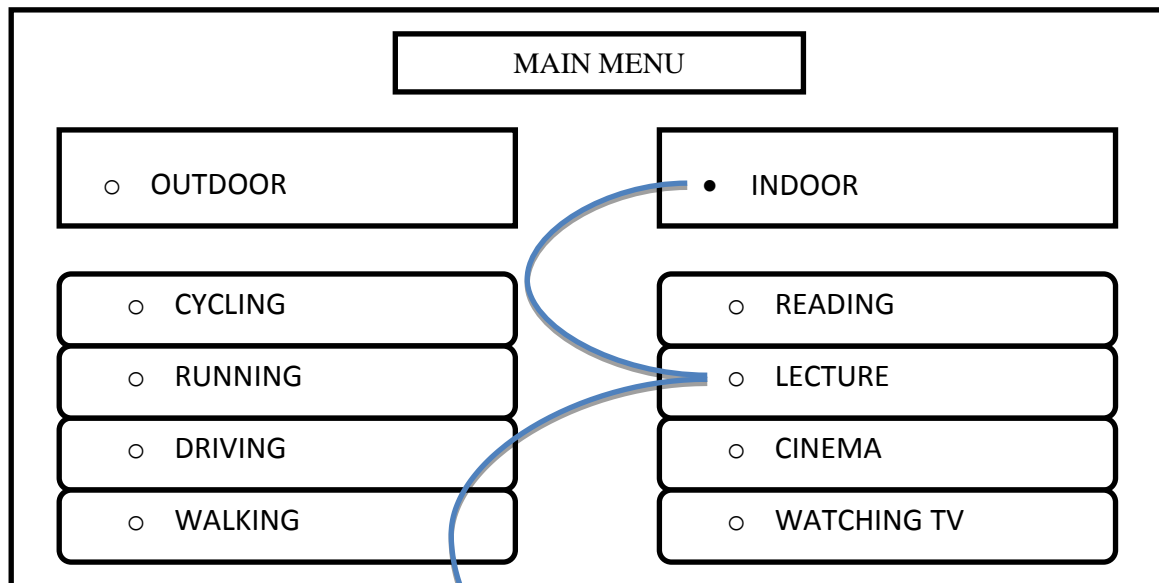


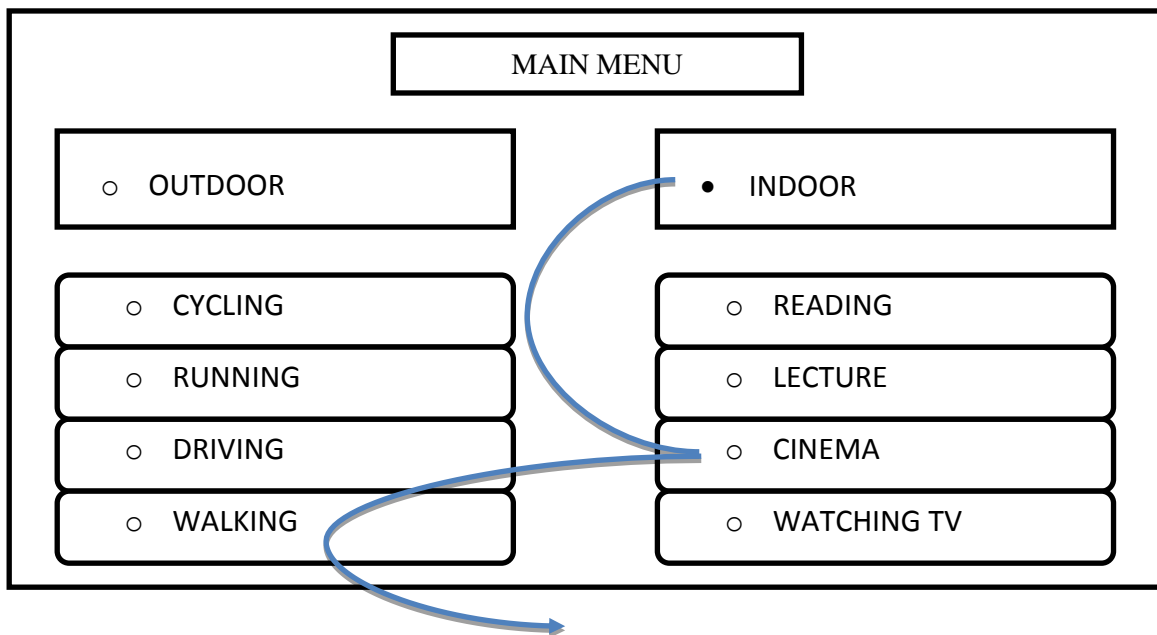
INDOOR

READING

MAGNIFIED
TEXT

MENU





Severity Rating	Meaning
0	This is not a usability problem
1	Cosmetic problem only: it will be fixed only if extra time is available
2	Minor usability problem: low priority on fixing it
3	Major usability problem: high priority on fixing it
4	Usability catastrophe: imperative to fix this before product can be released

	SEVERITY	WAYS TO IMPROVE
Visibility of system status		
Because system will be very simple, it is expected to load up in less than 10 sec.	0	
Match between system and real world		
Main menu is very simple, the only input that it needs is the outdoor / indoor and the sub – option.	0	
User control and freedom		
There is no back or exit button. The only option that a user has while he / she uses the glasses is the menu	2	Including an Undo and Redo button

button.		
Consistency and standards		
Main menu is very simple as well as the way that users choose the appropriate option and sub – option.	0	
Error prevention		
There is no prevention on accidental change of mode from outdoor to indoor and vice versa.	4	Implement a sensor that will measure the speed and it will “lock” into outdoor mode.
Recognition rather recall		
Two main options – Outdoor / Indoor Four sub – options for each main option.	0	
Some users may want more customization as well as more menus and options.	2	Enter more customization like contrast or white balance.
Flexibility and efficiency of use		
The system performs only one action (magnifying), which is fully automated.	0	
Aesthetic and minimalist design		
Very simple system	0	
These glasses may be quite big because of the big battery.	1	Insert a smaller battery – with less mAH, without hi – tech features, or make the system more battery

		efficiency.
Help error recovery		
In case of system crashing, the user has to restart it.	3	The system should restart on its own.
There is no message that the system restarts, so it will just turn off and on.	3	Enter messages that will pop when the system crashes and needs restart.
It may take a while in order to be ready for use again.	2	There must be an “option” of fast reboot, in order to restart in half time.
Help and documentation		
The system is simple because of the touchpad and the interface.	1	Include a user’s manual inside the package.

Evaluation (Personas Usage)

Older People – David Roland

- Scenario 1:

Mr Roland goes for a trip to visit his brother. He needs to take the train, so he should book a ticket. In order to do that, he wears the glasses and uses the reading mode, because he wants to read the table of arrivals. Using the same mode he will read his ticket easier than wearing his previous glasses. When he will arrive at the station he has to turn into walking mode. Apart from this, while he is traveling he needs the walking mode in order to find the toilet or the bar. As a consequence, Mr Roland will change the modes more than once, but the system has only a menu button. So, an Undo and Redo button would be significant.

Apart from this, wearing this pair of glasses during the trip will be quite tedious because of the big and the heavy battery. So, a smaller battery will be a beneficial change.

- Scenario 2:

Mr Roland takes a walk to the park with his grandchildren and his wife. He uses the walking menu in order to identify and avoid obstacles. But in case of a system crash he will not be able to identify the obstacles. So, the system should restart on its own but before restarting it has to pop a message mentions that the system is restarting.

- Scenario 3:

Mr Roland is invited to attend at a conference for new and former pilots. Wearing this pair of glasses and using the lectures mode he will be able to follow the conference. But in case of system crash he has to wait until the system starts restarting. This will take a while, so he needs an option of fast restart or fast reboot, which will restart the system in half time and it will return to the already selected mode.

- Scenario 1:

Mr Doe wants to travel by car to Liverpool for a seminar to get informed on the new taxing law but he is going to be driving on his own. Although he has a navigation device, he wants to be able to read signs on the motorway from a longer distance. Using the driving option he can do that. But there is a major problem. What is supposed to be done if the mode will change by fault? So, it is very important for a user who drives a lot to have the ability to lock the mode. This could be done with a lock button.

- Scenario 2:

Mr Doe wants to attend the seminar but he knows that a lot of people have enrolled and is considerate if he will find a seat on the front rows because he struggles to read slides from a long distance. Definitely, this device does exactly what he wants. By using lecture mode, the slides will be magnified and he will be able to follow the seminar. Due to the fact that this system displays in a dynamically position, it does not matter how much the distance between Mr Doe's seat and the slides will be, because if the distance is bigger, the system will display a bigger "screen".

- Scenario 3:

Mr Doe's job requires him to go through a lot of tables with numbers, which is very tiring to his eyes. Taking into account that he wants to read these tables of numbers, he has to select the reading mode, which will magnify the text. This will help him on reading such tables.

Visually impaired children – Sarah Johnson

This type of persona has a serious problem with his vision. Specifically, she has a problem in her neural system. So, it is impossible for this persona to get better vision through this pair of glasses. However, there are lots of children that have a poor vision, this type of problem can be eliminated using this system. Children spend a lot of time playing. Additionally, children fight each other. So, children must hold devices that can stand a lot of pressure and mistreatment.

People with no visual impairment problems – James Tech

- Scenario 1:

James holds every new technological product. He uses them every day and he is very proud about his collection of gadgets. Everyday, he goes to his course with a different gadget. So, wearing this pair of glasses will be something new for his classmates who will watch him. Such persons do not care about the way their gadgets are looking like but they really care about the customization. So, it is important for him having lots of options and modes for every situation. Finally, he would like more features in this kind of gadget such as connecting to the Internet, having a navigator etc.

- Scenario 2:

James uses his car a lot. He has a navigator in his car and a GPS application installed on his phablet. However, he wants to be able to watch the signs on the motorway on his own. Using the driving mode the signs will be magnified and he will be able to identify them from a long distance. But, in case of a change during driving it will be very dangerous. So, it would be important for him that the system will have sensors, which will understand the speed and as a consequence the system will be “locked” at driving mode.

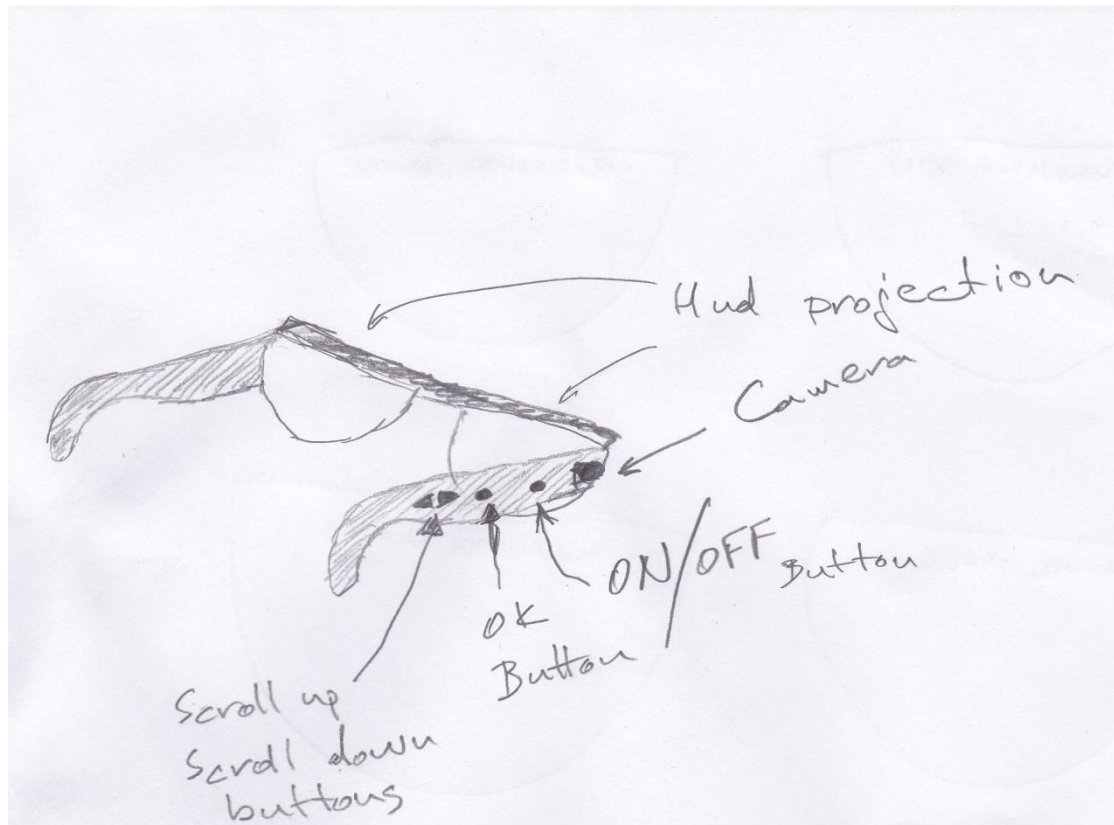
Apart from this, James loses his attention a lot of times. So, he really needs this system because it identifies the objects in front of him i.e. cars or trees and it informs him for the distance.

- Scenario 3:

He starts studying from his e – book and after two hours he needs a break because he is tired. Using reading mode he will be able to read text in small font size because he will watch it magnified.

Prototype 3

Information that is of great interest is displayed on glasses the user wears. To be exact, it quite resembles a HUD (Hud up Display) and information is displayed on lenses with or without optical correction, depending on the user. A camera that are attached to the side of the frame can take input from the surrounding environment and the system can operate accordingly. For instance:



The following modes are available to the user:

- DRIVING MODE
- SEMINAR MODE
- MOVIE MODE
- READING MODE

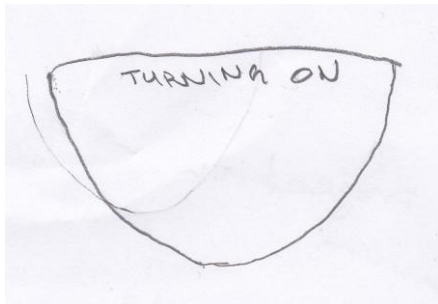
The user can navigate to these modes by pressing the FORWARD or BACKWARD buttons. The modes are in a linear form and so every press of the button moves you through the modes.

Driving

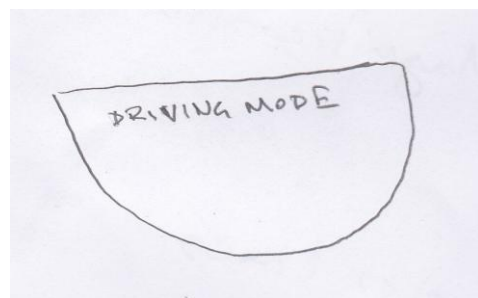
The system is able to recognize signs on the street and show a magnified image of the particular sign on the top left or the top right corner of the users optical field.

The system will also be able to recognize obstacles on the road and highlight them in red color.

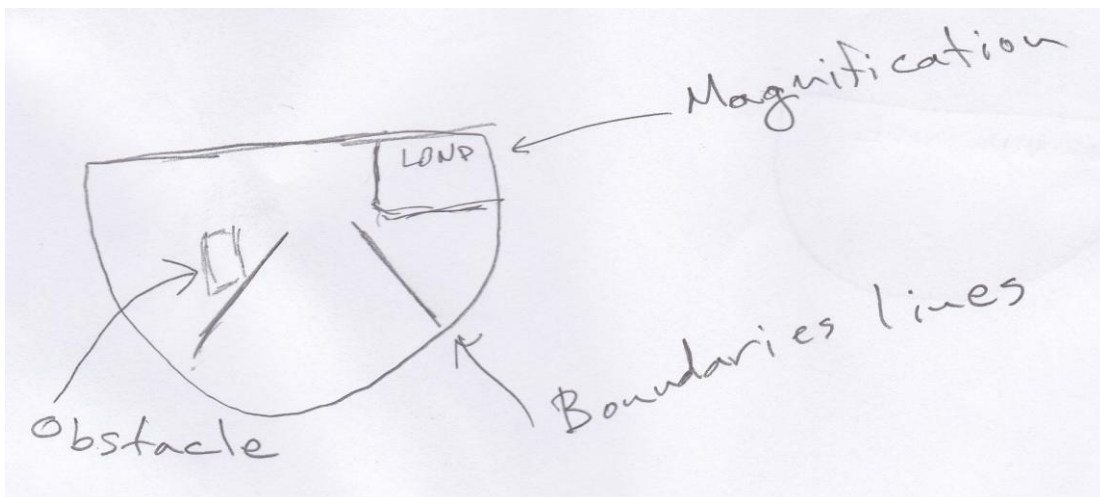
The road can be recognized by the camera and two lines appear on the user's lenses that show the boundaries of the lane the user is driving on.



The user turns on the device
with the on button



The user navigates to DRIVING MODE
with the Forward Arrow button



The user selects the DRIVING MODE with the OK button

The recognition of signs on the road can be easily implemented as algorithms for object recognition are already in production. A sign on a motorway is an object that can be easily recognize by these systems as its shape and colors are very specific (Rectangular shaped, Green color, Containing Text). The road also is fairly easy to identify (Dark color, Stretching to the front, white lines drawn on each side of the lane the driver is driving and the size of the lane is more or less specific). Obstacles on the road on the other hand are of different size, shape and color and much harder for the system to recognize but this technology is being implemented and tested by some car companies on their production cars.

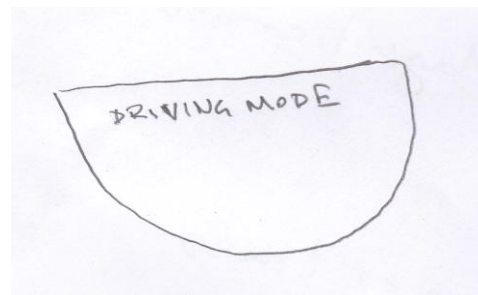
Seminar Attendance:

A projected screen can be recognized by the cameras and a magnified version of this can be displayed occupying the top half of the user's optical field. This can be accomplished by shading the lens accordingly.

The bottom half of the lens stays crystal clear so the user will be able to have some vision of his surroundings and especially being able to take notes without frustration, as the user will be able to look down on the notepad he/she might have in front of him/her.



The user turns on the device with the on button



The user navigates to DRIVING MODE with the Forward Arrow button



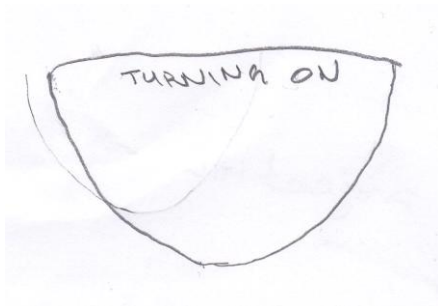
The user navigates to SEMINAR MODE with the Forward Arrow button



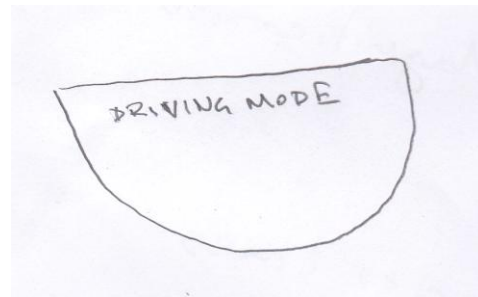
The user selects the DRIVING MODE with the OK button

Watching a movie

In this case the user is not interested in magnifying the whole picture because the cinema experience is not constraint on a specific part of the image projected. Rather the user might be interested in magnifying subtitles (especially if the movie's dialogs are in a foreign language). In this case only a small portion of the lens (roughly a 5 - 7 %) at the bottom should be shaded and the subtitles can be displayed magnified.



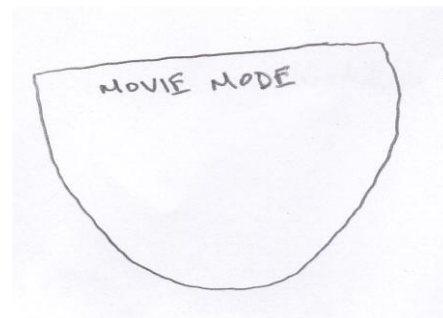
The user turns on the device
with the on button



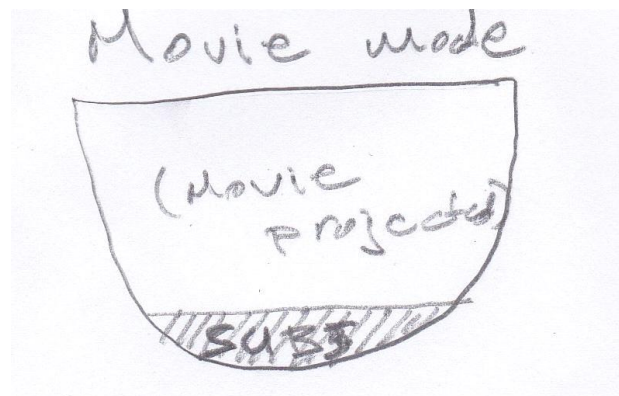
The user navigates to DRIVING MODE
with the Forward Arrow button



The user navigates to SEMINAR MODE
with the Forward Arrow button



The user navigates to SEMINAR MODE
with the Forward Arrow button



The user selects the
MOVIE MODE with the OK button

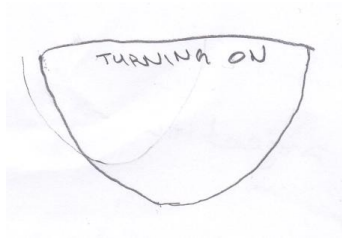
Reading

In this case the whole lens can be shaded and a magnified image will be displayed. In this case the user is interested in being able to read a book or a newspaper and so visual stimulus from the environment is unimportant as the user most probably will not be moving.

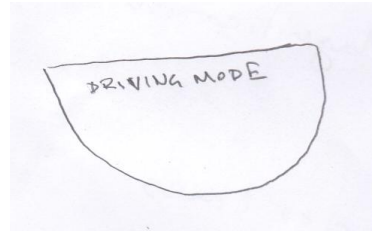
As far as seminar attendance, watching a movie and reading is concerned the image that is being captured by the cameras is in most cases a typed text. Because of this OCR (Optical Character Recognition) technology can be implemented in the system and the magnified picture does not have to be an actual magnified picture of the real world but rather a text produced by the OCR with a greater sized font.

The lenses shading can be achieved by implementing liquid crystal technology and shade a portion of the lenses accordingly.

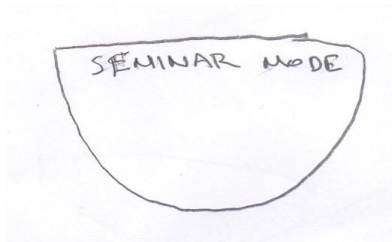
One can assume that the human eye will not be able to focus on the information displayed on the lenses. This is not the case as in other products such as virtual video glasses and night vision goggles suggest that this can be achieved.



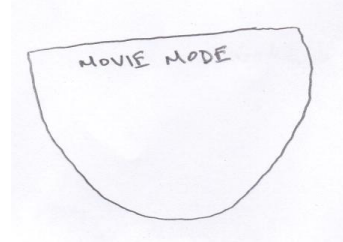
The user turns on the device with the on button



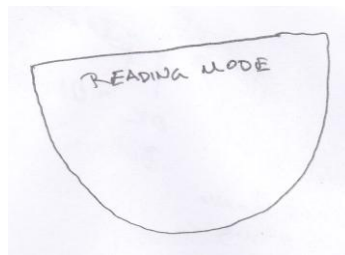
The user navigates to DRIVING MODE with the Forward Arrow button



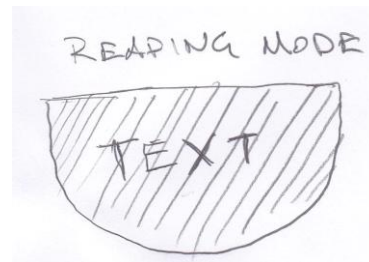
The user navigates to SEMINAR MODE with the Forward Arrow button



The user navigates to SEMINAR MODE with the Forward Arrow button



The user navigates to READING MODE with the Forward Arrow button



The user selects the READING MODE with the OK button

Assessment

Because the system is designed as standalone (works on its own) in order to implement the computing power and the battery capacity it is probable that the system will end up being quite bulky.

It is possible that a percentage of the users will not feel comfortable having information displayed so close to their eyes and it is possible that this will make them feel dizzy.

The user will have to input some information to the system regarding what situation he/she wants to use it. This information can be inputted through 4 button on the right hand of the glasses. There will be an on/off button, scroll up, scroll down and an enter button.

It is probable that some of the feature that need to be implemented on the system are governed by patents as these features appear on other systems that are currently produced or are being developed.

Evaluation & Assessment – Prototype 1

Personas Usage

Older people

Older people may not feel comfortable wearing something this futuristic.

Inputting information in the system may seem challenging for them

It is another device that needs to be charged overnight and will not be able to work otherwise. Remembering to charge it on a daily basis is something that older people are not accustomed to.

Having information displayed closely can be distracting for them and therefore will not feel quite comfortable using them

Persona – David Roland

Scenarios Evaluation

- **Train trip and cab to his brother**

The glasses Mr. Roland wears do not help him achieve his goal as the system does not have a function to cover this need. After scrolling through all of them he manages to magnify text by switching to Reading or Seminar mode but he is not happy with the way text is presented to him as he is not able to have any see which buttons on the ticket machine he is pressing.

- **Everyday activities / Walk to the park**

The system is not designed to help him in any kind of everyday activities. It is only designed to help the user to drive or magnify text as long as the user does not have to interact with his surroundings.

- **Conference**

Mr. Roland can use the Seminar mode if he wants to have a magnified image and have the opportunity to have some sense of his surroundings or the Reading mode if he just wants to have a magnifies image of the slides. He is not very happy with the fact that he is not able to have magnified image of everything that happens around him.

Observations and Conclusions

Mr. Roland feels that the is not designed for him as he can only actually use it to attend a seminar and still it is not satisfactory for him

Children

Due to the bulk of the system and the fact that children are very active in their everyday tasks it is not the most suitable product to be used by them.

Using the system and inputting information will certainly not be a problem for children as most technology products are quite intuitive for them. Think about it for a moment. No one has to teach children how to operate a television, a mobile phone, or even a computer. It is something that is everyday operations for them as they are surrounded by these devices ever since they were born. This wasn't the case for older generations.

Persona - Sarah Johnson

Scenarios Evaluation

- **Everyday Activities**
No mode can help her in her everyday activities.
- **Playing**
No mode can help her in her everyday activities.
- **Doing homework**
Sarah need a device that magnifies everything around her as she needs to read and write. Seminar mode is obviously not for her as she need to write in her textbooks.

Observations and Conclusions

This device fails to cover any scenario related to Sarah and obviously is not appealing to her.

Young people visually challenged

This category of users are most probable to be using the device with almost no problem. Some may feel uncomfortable regarding the fact that information is shown close to their eyes. Inputting information to the system will most certainly not be an issue for them.

This category of users probably know exactly what the system will be capable of doing and in which situations it is most suitable for.

The fact that their prescription glasses can be implemented in the system is certainly a bonus.

In cases where the system is not being used the user will have to wear a bulky device instead of his/hers traditional glasses. This leads to these users having to carry around their glasses most of the time and switching back and forth accordingly to the situation.

Persona – John Doe

Scenarios Evaluation

- **Driving**

John found that the system was very easy to use. It gave him all the information he needed in order to feel comfortable to drive.

- **Seminar**

John was very happy that he could see all the information projected during the seminar. He also found very useful the fact that he could keep notes while he was using the glasses. The fact that the system uses OCR technology to magnified text did not always worked properly as the format of the text was

Observations and Conclusions

John is quite happy with his glasses as although their functions are quite limited the ease of use they provide is something he enjoys.

Techies

This category is going to be proud of owning and using the latest and greatest tech gadget of the market.

Using the system will obviously not be a problem to them as using different kind of products is an everyday thing for them.

Wearing a futuristic gadget where everybody else can see (their head) is something that will make them very happy.

Charging another everyday devise is certainly not an issue as they most probably own a huge collection of chargers in their drawers in order to charge all 53 devices they own and use simultaneously.

Persona – James Tech

Scenarios Evaluation

- **Personal Satisfaction**

Although this is a high tech device James feels that it is not what he was expecting for. The device is very simple and not customizable whatsoever.

- **Driving**

The information displayed is very useful for James but the simplistic design is not to his liking.

- **Reading**

Although it is much easier for him to study the fact that he is being visually isolated to the text is not satisfying for him.

Observations and Conclusions

James feels that these glasses are quite cheap as there is no customization and the mode system is very simplistic.

Evaluation (Nielsen's Heuristics)

Evaluation method used: Nielsen's Heuristics

1. Visibility of system status
2. Match between system & real world
3. User control and freedom
4. Consistency & Standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility & Efficiency of use
8. Minimalistic design
9. Help error recovery
10. Help & Documentation

Evaluation rates:

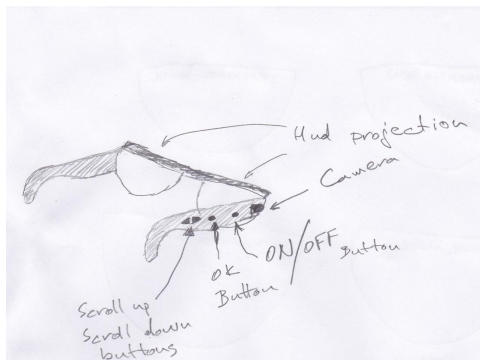
- 0 – don't agree that this is a usability problem
- 1 – cosmetic problem
- 2 – minor usability problem
- 3 – major usability problem; important to fix
- 4 – usability catastrophe; imperative to fix

	SEVERITY	WAYS TO IMPROVE
Visibility of system status		
The system is expected to start up and be ready to be used in times of less than 5 sec. The system's menu for mode selection is very simple.	0	Even though the menu is very simple it might feel a bit cheap as most devices nowadays are providing customization. Most users will want to have some kind of options so they can customize their device to their own personal taste.
Match between system and real world		
The only input the user is asked to input in the system is to choose the mode he/she wants to use, making the system easily understandable by most users.	0	
User control and freedom		
The modes the user is allowed to choose are only 4 and can be chosen as the user scrolls through them via up and down buttons.	0	
Consistency and standards		
The user chooses the appropriate mode and the mode's name is displayed for no less than 1 second and no longer than the time it takes the system to boot that mode.	0	
Error prevention		
There is a serious problem regarding an accidental change of mode especially from Driving to Seminar or Reading mode as the lenses are going to be shaded.	3	The device must prevent the change of mode from Driving through a lock button or some kind of sensor that recognizes whether the user is driving and so preventing an accidental mode switch.

Recognition rather than recall		
User does not need to remember anything shown on the menus as it is quite simplistic.	0	
Flexibility and efficiency of use		
The system performs fully automated and is intended to do only the actions that are described above.	0	
Aesthetic and minimalistic design		
Very simple system.	0	
The system is expected to be quite bulky and so some users may be discouraged to use it especially in public which makes the seminar mode quiet useless for them.	2	The technologies used in order for the system to work properly must be researched in order to implement the system in an as much most compact device as possible.
Help error recovery		
In the case the system crashes the user needs to restart it, which is something that most users will do intuitively. No need for error messages.	2	When the system crashes the lenses must always be crystal clear and not shaded in order to be safe for the user. Even though the user will not receive any kind of assistance from the system his vision will not be constrained (like lenses shading) by a possible system failure.
Help and documentation		
The system will have 2 scrolling buttons, an enter button and an on/off button . No need for much documentation.	1	A hard copy of instructions should be given with the device to describe how to move in the menu system and basic information for safe use of the device.

Second Generation - High fidelity

The 2nd generation prototype was created by making use of the best elements of the three 1st generation prototypes, while trying to eliminate all of the negative aspects of those prototypes as well. It was heavily influenced by the third 1st generation prototype, which was based on simplicity, while adding more complex features from the first and second 1st generations prototypes. Since being a gadget of visual enhancement and since its target audience are mainly people with visual problems (either severe or not), its user interface was designed having simplicity in mind. Easy to distinguish colors and buttons, as well as the use of multiple symbols are some of the design's basic principles. The main idea was to make the product easy to use and accessible to all.



As far as the design of the glasses goes, the second prototype uses almost the exact same design as the third 1st generation prototype. The user can navigate using the right and left Arrow keys and confirm his choice by clicking the OK button. The Power on / off button can be used to turn the device on and off, if pressed constantly, but can also be used as a lock button if tapped only once. Such a lock button might prove useful for modes that include driving or running. To go back or exit a feature, the user can tap on the device's Return button, which unlike the rest of the buttons mentioned above, is placed on the left side of the glasses, to avoid accidental tapping and confusion.

User Interface

Main Menu

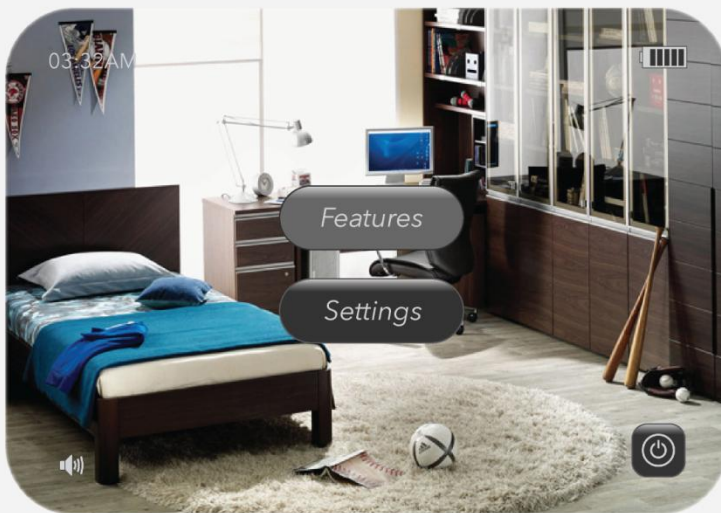
- Features
- Settings

Features

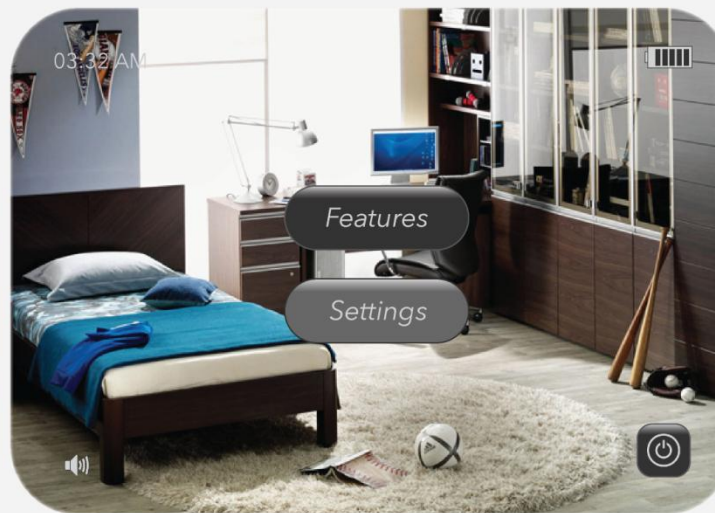
- **Indoors**
 - Reading
 - Lecture
 - Cinema
- **Outdoors**
 - Walking
 - Running
 - Driving

Settings

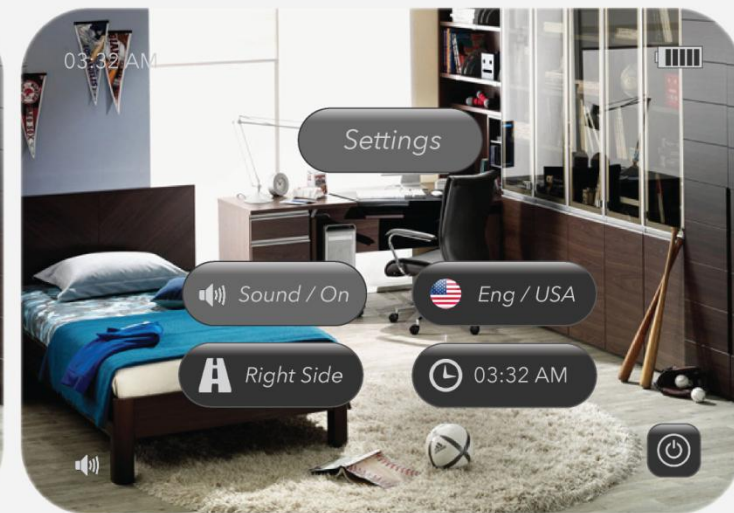
- Sound
- Language
- Driving Side
- Time



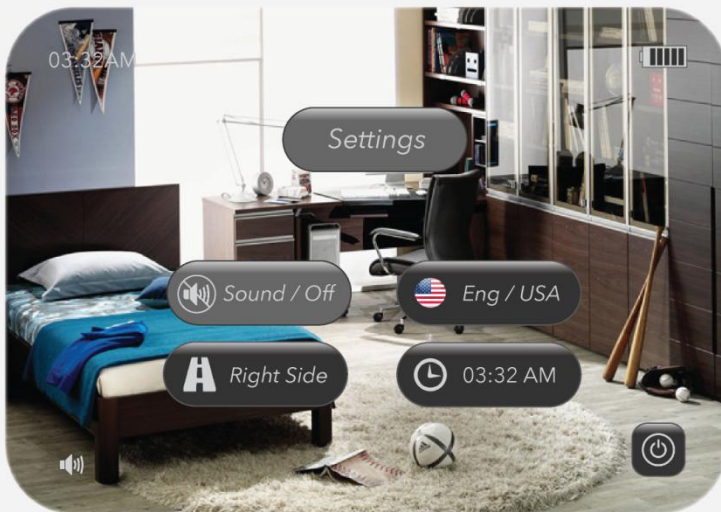
The user turns on his newly bought device. The main menu consists of 3 options: **Features**, which directs the user to the main features of the device, **Settings**, which allows the user to change the factory settings of the device, and **Power Off**, which if clicked by the user, turns off the device.



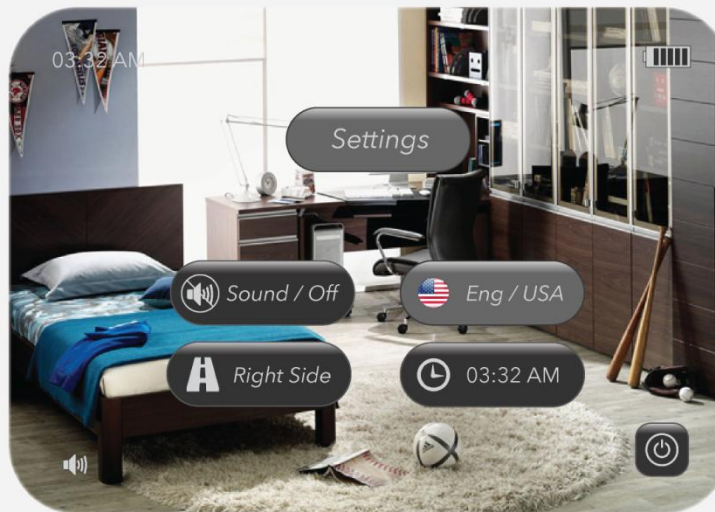
Apart from these 3 options, the menu includes the device's remaining *battery* life (in the above slide, the battery is full), if the *sound* is on / off (in our case it is on), as well as the current *time* of the day (03:32 AM). However, the user wants to change the factory settings, therefore that is why he clicks on Settings.



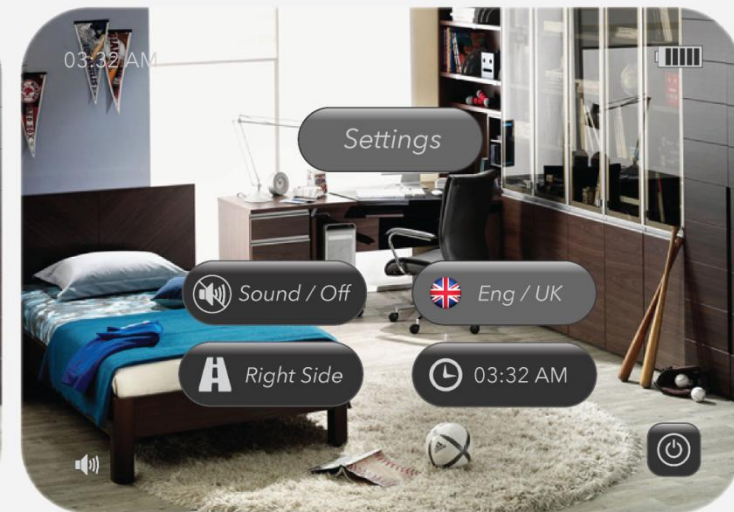
The **Settings** menu of the device is now displayed to the user. It consists of 4 options: turning **Sound** on / off, selecting a desired **Language**, **Driving** on the right / left side of the road (connects to Driving mode), setting the current **Time**. The user first turns off the sound by clicking the device's OK button.



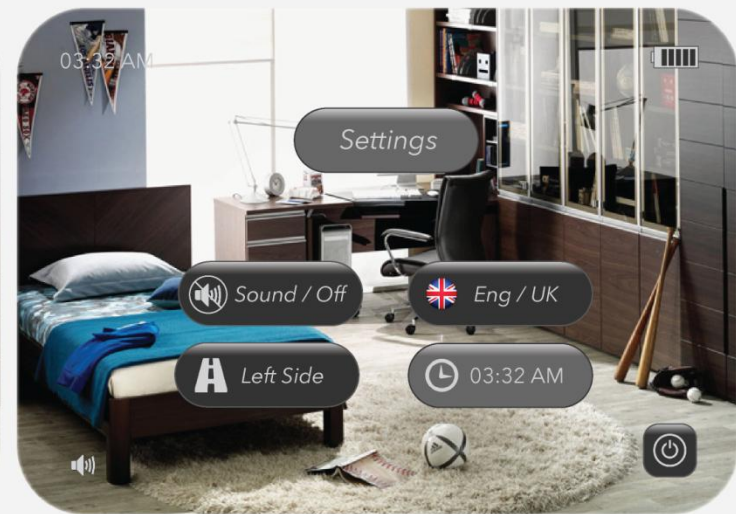
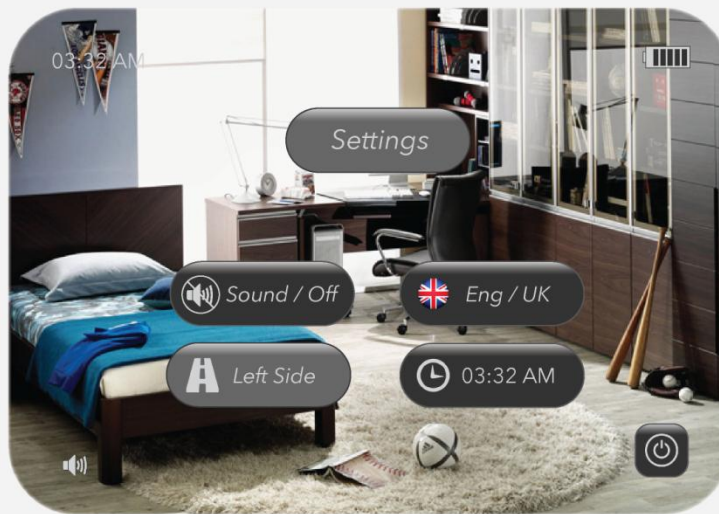
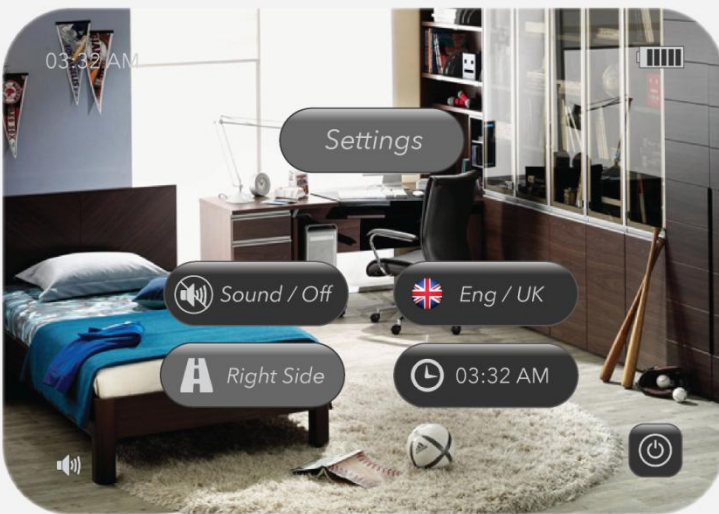
The device's sound is now turned off. Although audio may only be heard when the side buttons of the device are pressed or when battery is very low - as a warning to the user - it is vital that the option to turn sound off has been made available, in order to instantly handle situations which require total silence.



The user lives in the United Kingdom, but the device has American English as its factory set language, so he decides to switch to British English, by firstly clicking the OK button, enabling the Language option, and then clicking the glasses left arrow button once. Eng / UK <-- Eng / USA (Alphabetically)



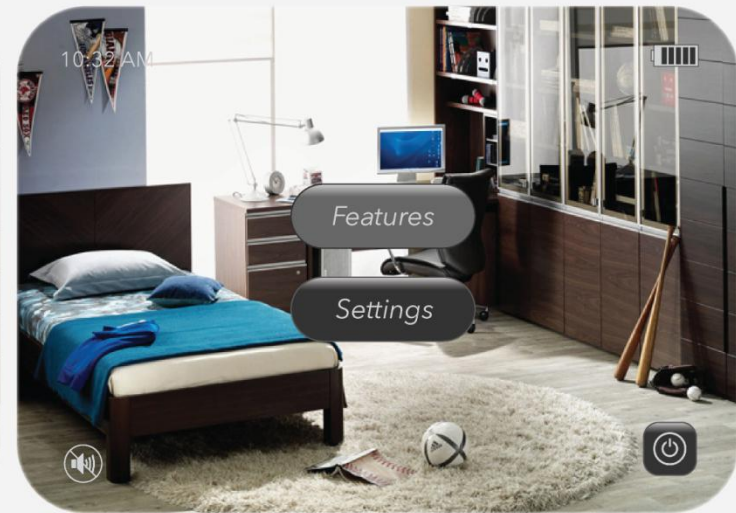
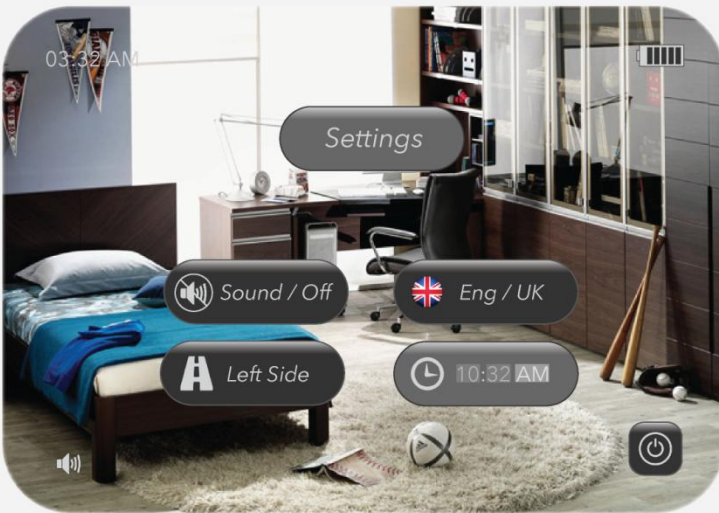
The language is now set to British English satisfying the user. The device supports over 30 different languages in total, making it more relatable and easy to use for various people around the world. Apart from English, the device supports Chinese, Hindi, Russian, French, German, Spanish, and many more.



Another device option that the user must change is Driving, which is factory set to Right Side driving. As mentioned before, the user lives in the UK and therefore that is why right side driving is of no use to him. That is why he clicks on Right Side deactivating it, simultaneously activating Left Side driving.

LS driving has now been activated and therefore immediately connected to Driving Mode, one of the device's six main features (to be introduced later on). The user will now be able to drive around the United Kingdom with ease and safety, taking advantage of all that Driving Mode has to offer.

The last customization option that the device offers is setting the current time. On the above slide the time is 03:32 AM, which is 7 hours behind UK time. The user is obviously not pleased with the factory set time and enables the Time option by pressing the glasses OK button, to set his desired time.



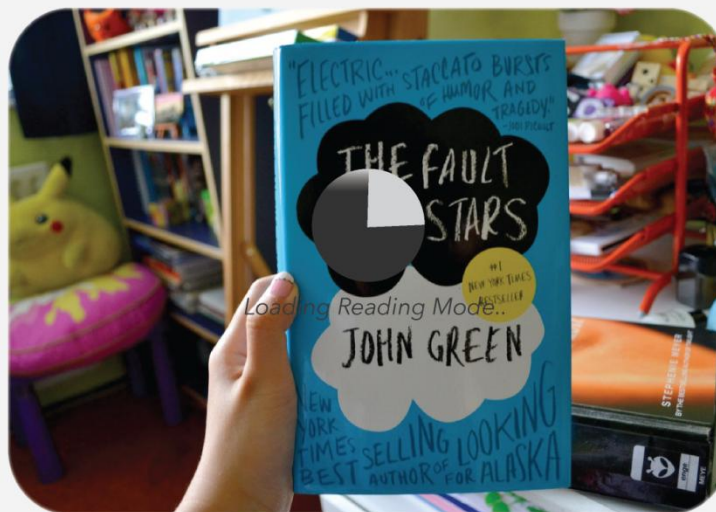
The hours are the first to be selected in Time edit mode. By clicking the OK button and then the left / right arrows the user can set the desired Hour time, and confirm it by clicking OK again. The same applies for the Minute and the AM / PM option. To exit Time edit, he must press the device's Exit button once.

Our user has made all desired changes to the device's settings and has adjusted it to his own personal preferences. Satisfied with the changes he clicks the glasses Exit button and selects Save & Exit, which saves his changes and exits the Settings. Not to save or continue editing are two other options available.

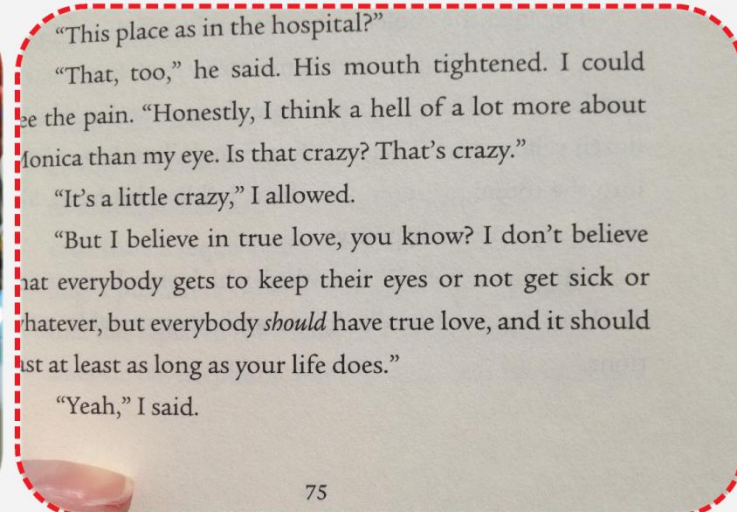
All changes have now successfully taken place as seen in the above slide. The hour has changed and the sound is muted, existing as a reminder to the user that the device has no audio at the moment. The changes on language and driving have occurred as well, although not currently visible to the user.



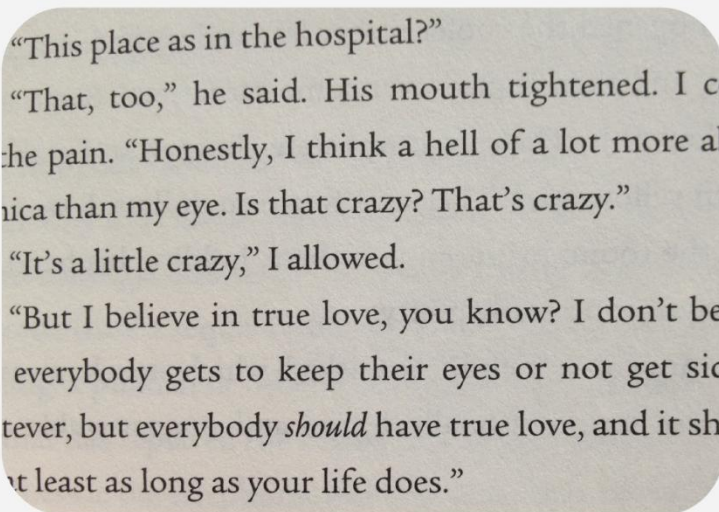
The user wants to read a new book that was recently gifted to him. Therefore he opens the device, clicks on **Features** and selects **Reading** mode from the **Indoors** category by pressing the OK button on the side of the glasses.



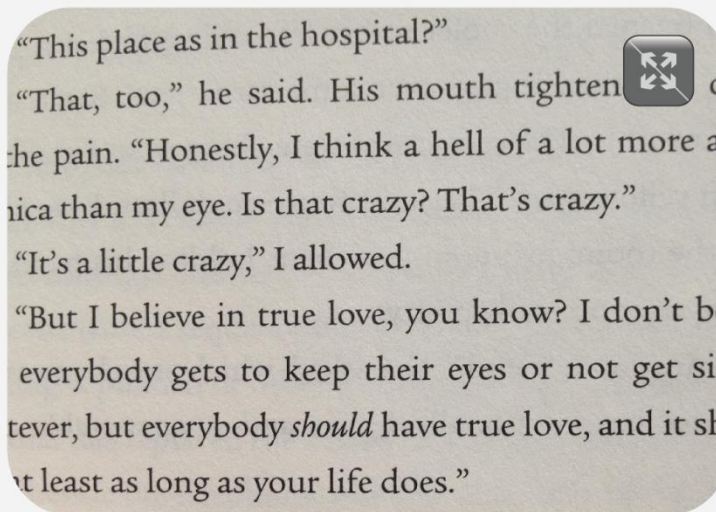
As soon as the device's OK button is pressed, the *time*, *battery*, *sound* and **Power Off** symbols and button respectively fade out and a loading icon appears on screen. Loading does not take more than 5 seconds to complete. Reading mode then commences.



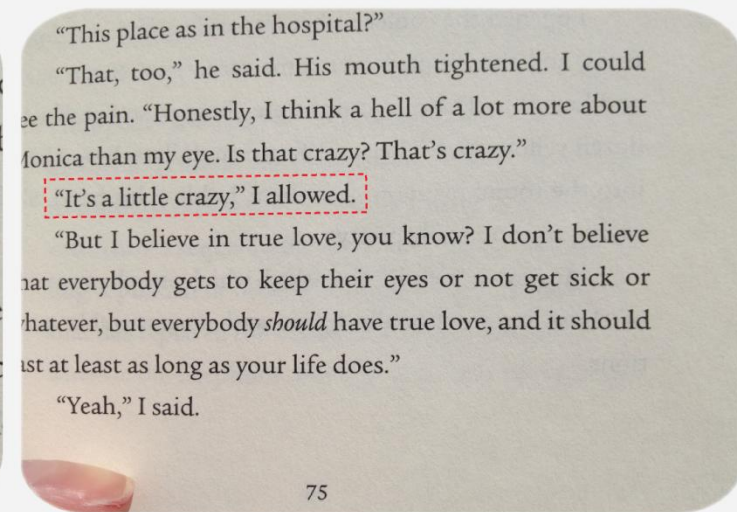
Reading mode's main feature is its ability to magnify text up to an automatically adjusted zooming x level, using OCR technology. To do that, it first detects the text, by surrounding it with a red dotted rectangle, depicted on the above slide.



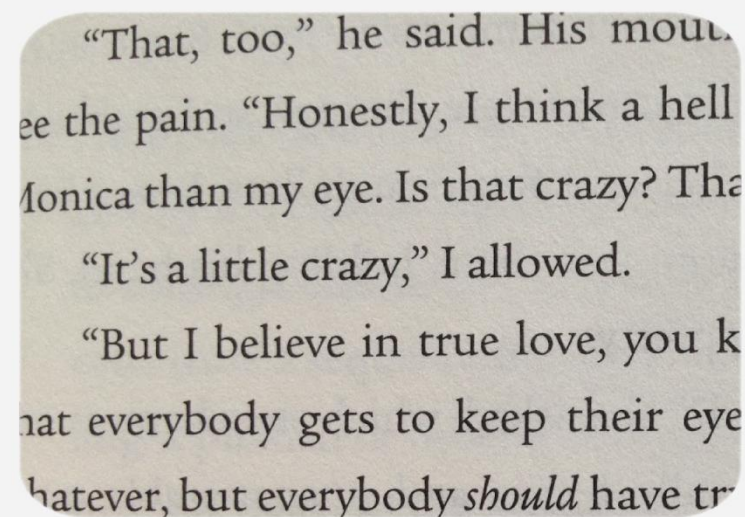
After the text is detected, the rectangle fades out. The text is then immediately zoomed in and the user can now distinguish each letter with ease and therefore read the book effortlessly.



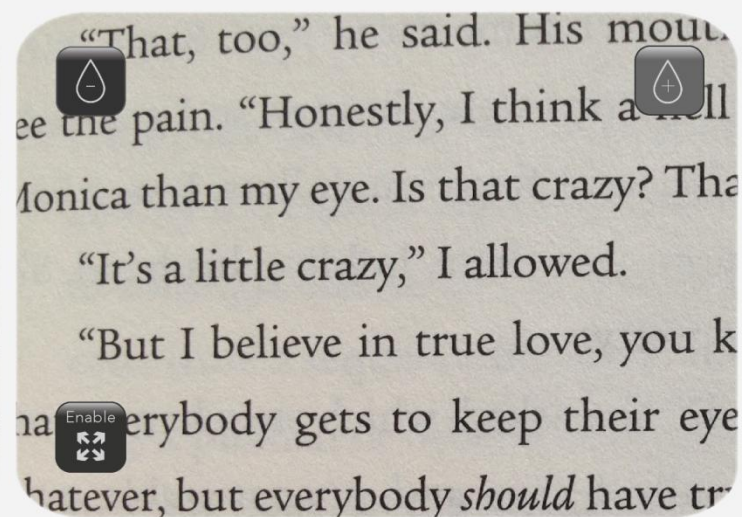
After reading a couple of lines using Reading mode's magnification option, the user has a sudden change of heart. Therefore, he presses the glasses OK button once and the **Disable Magnification** button appears on screen. He presses OK again and disables the option.



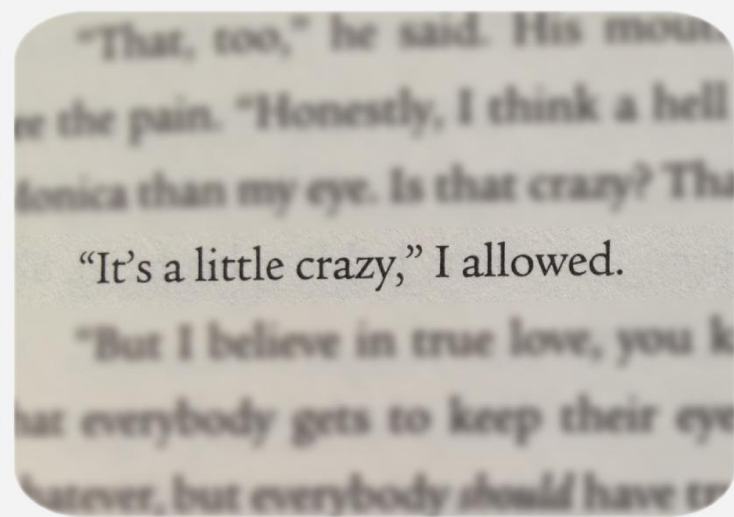
With magnification now turned off, the glasses automatically activate Reading mode's secondary option, which detects and focuses on each line of text separately, according to where the user is looking at, using OCR technology again, surrounding the text with a red dotted shape that adjusts to the line's form.



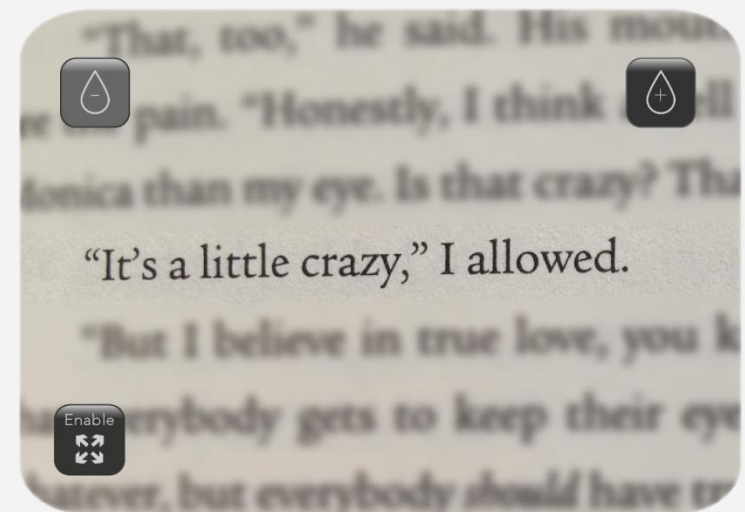
The text is now zoomed in again, but this time it is centered according to the line that was detected in the previous slide. This alternative mode gives the user the choice to blur the surroundings of the line on which he is currently focusing on.



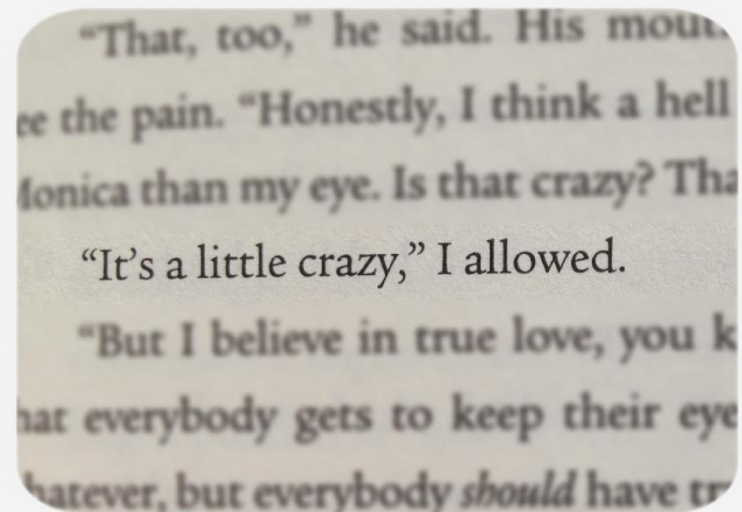
Therefore our user decides to blur the surroundings of the line, by firstly clicking the glasses OK button so that the mode's options become available. The options consist of **Blur More**, **Blur Less**, and **Re-Enable**, Reading mode's previous feature. In this example, our user decides to increase the blur.



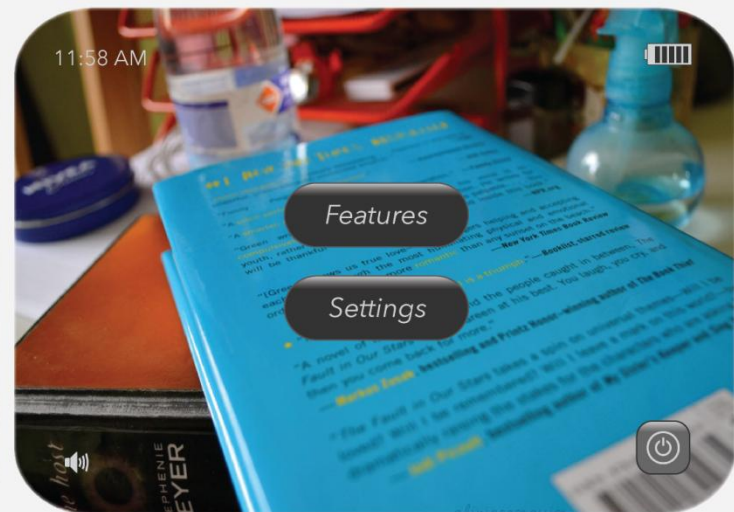
The screen is now entirely blurred and the only thing which is clearly visible to the user is the line of text he is currently on.



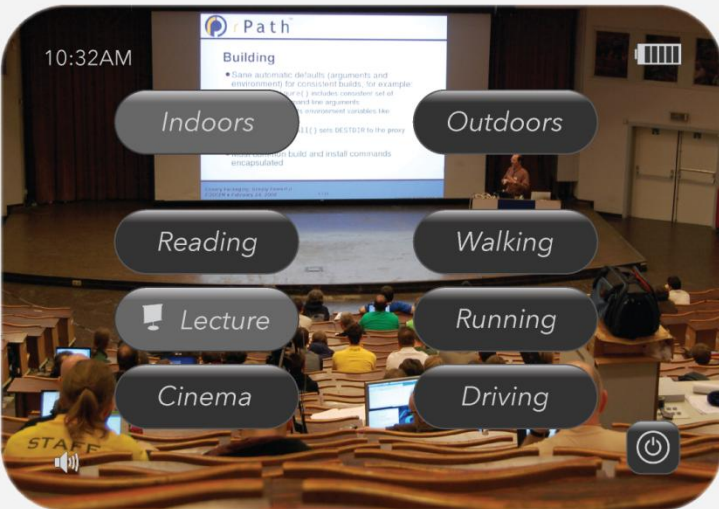
After a few seconds the user changes his mind and taps the device's OK button, activating the mode's option buttons again, deciding to decrease the blur this time, by clicking on the **Blur Less** button.



The user is now satisfied with the amount of blurriness surrounding the line of text on which he is on and so decides to continue reading the rest of his book in this specific mode and state selected.



The user has successfully finished reading the book for now and exits Reading mode, returning to the device's main menu by constantly pressing on the glasses Exit button. He then turns off the device, since he has no need of it for now.



The user, a university student, is attending one of his lectures, that is being conducted in the university's main lecture theatre. Having intensive difficulty in being able to see something that is far away, our user opens the device and selects **Features** and then clicks **Lecture** from the device's **Indoors** section.



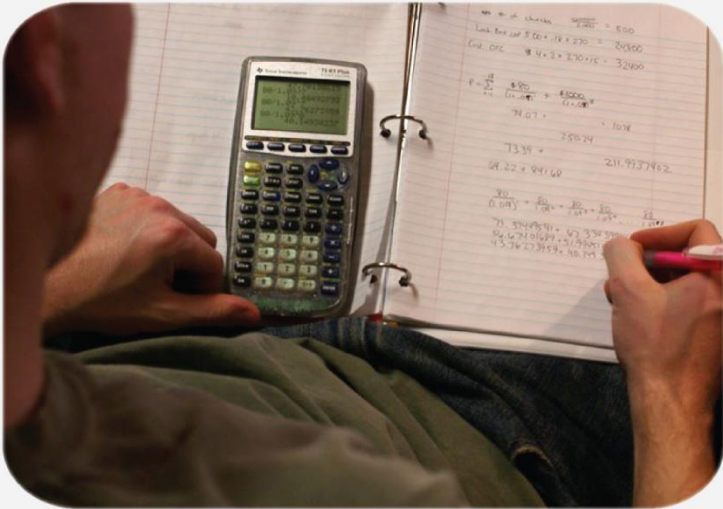
As soon as the devices OK button is pressed, the *time*, *battery*, *sound* and **Power Off** symbols and button respectively fade out and a loading icon appears on the screen. Loading does not take more than 5 seconds to complete. Lecture mode then commences.



Lecture mode's main feature is its ability to magnify a detected projected screen up to an automatically adjusted zooming x level. To do that, it first detects the screen, by surrounding it with a red dotted rectangle, depicted on the above slide.



After the screen is detected, the rectangle dissappears. The projected screen is then immediately zoomed in and the user can now distinguish what is written with ease and therefore keep track of what the lecturer is talking about. The magnified screen is not depicted on the full lens, allowing the user to have a perception of his real world environment as well, something which can provide a sense of safety and reassurance.



When the user wants to take notes and the screen is out of his optical field or is not fully detected by the system, magnification of the screen is automatically switched off and then turned back on again when the user raises his head. The screen does not have to be re-detected because the device stores its position and dimensions in memory for a total of 30 seconds, giving the user time to move his head freely.



After using Lecture mode's main feature for a while, the user decides to turn it off it by clicking the device's OK button once, making the **Deactivate Magnification** button appear and then clicks OK again, disabling the main feature, while switching to Lecture mode's alternative, secondary zooming option.



Zooming mode offers the user the choice to zoom in or out on the screen when and as he pleases. Before the user can do so though, the projected screen has to first be detected. A red dotted shape that takes the form of the screen, surrounds it, and fades out when detection is complete.



The user can now zoom in and out when and as he pleases. By clicking the glasses OK button the zooming options appear. The options consist of **Zoom In**, **Zoom Out**, and **Re-Enable**, Lecture mode's previous feature. In this example, the user decides to zoom in on the projected screen.



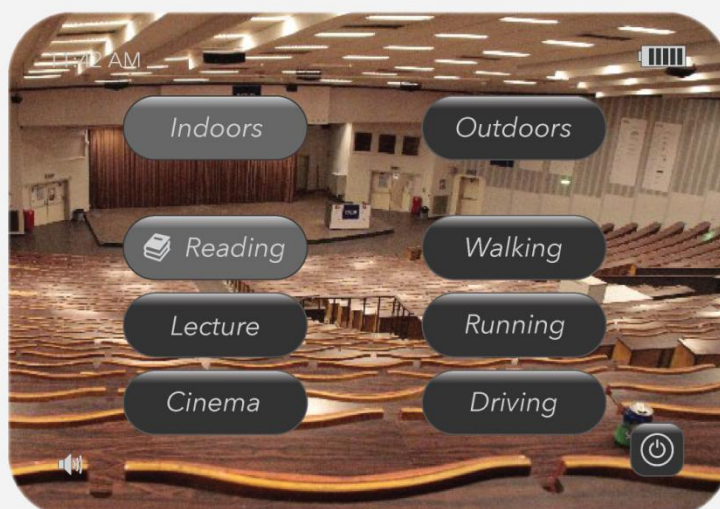
The screen is now zoomed in according to user preferences. The slides are more distinguishable and the text is clear and can be read through with ease, satisfying the user, as well as making the attendance of the lecture a less frustrating experience, with the student focusing more on what is being taught.



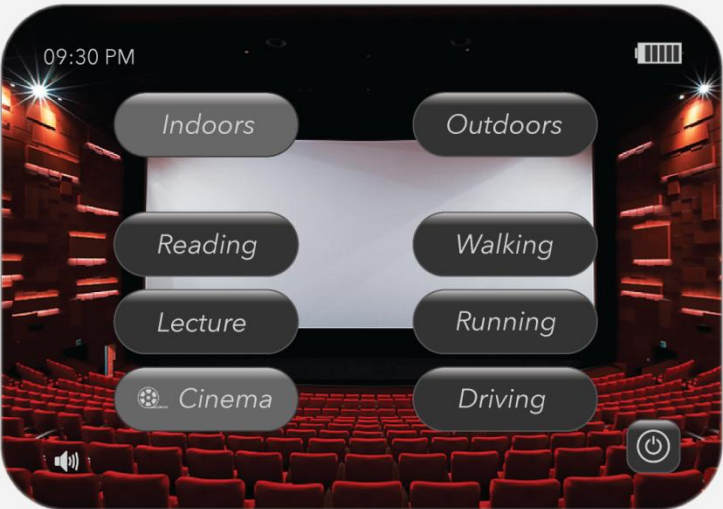
The lecture is ending and so the user decides to slightly zoom out. To do that he presses the glasses OK button to activate the mode's available options, and then while the **Zoom Out** button is highlighted, clicks OK again enabling it, tapping repeatedly as many times as he wishes, to zoom out accordingly.



The user has now stopped tapping zoom out, the optional buttons have faded out, since no longer used and the student is satisfied with the screen's depicted visual distance. Therefore, he continues paying attention for the lecture's few remaining minutes and when the lecture ends returns to the main menu.



The lecture has now ended and our user has exited to the main menu of the device, by constantly pressing the glasses Exit button. After successfully attending the lecture, the student decides to stay in the now empty lecture theatre and study on his own. Therefore that is why he continues making use of the device, selecting **Reading** mode.



The user wants to watch a French movie and therefore, after entering the movie theatre, turns on the glasses and selects **Features**, and from the **Indoors** category chooses **Cinema**. He then taps the device's OK button and loading begins.



As soon as the device's OK button is pressed, the *time*, *battery*, *sound* and **Power Off** symbols and button respectively fade out and a loading icon appears on screen. Loading does not take more than 5 seconds to complete. Cinema mode then commences.



Cinema mode's main feature is its ability to automatically magnify the subtitles of a movie to an automatically adjusted zooming x level, using OCR technology. To do that, it first detects the text (subtitles), by surrounding it with a red dotted rectangle, depicted on the above slide.



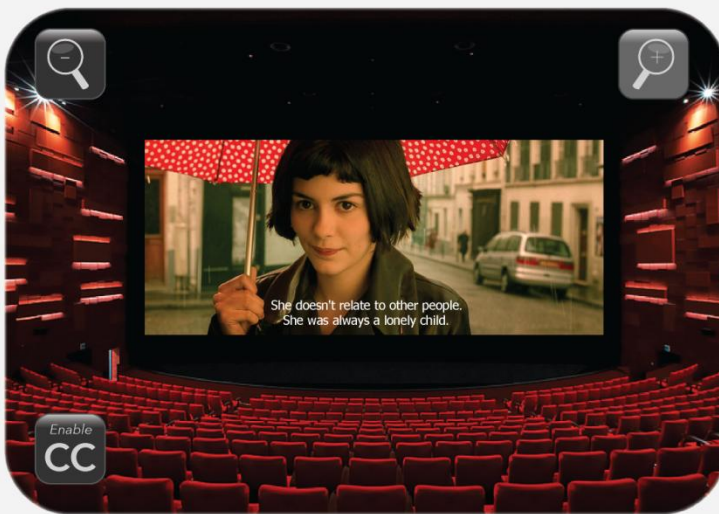
After the subtitles have been detected, the rectangle fades out. The text is then immediately zoomed in and the user can now distinguish each letter with ease and therefore read the subtitles effortlessly. To facilitate user needs, the subtitles are surrounded by a black filled rectangle, making them even easier to read.



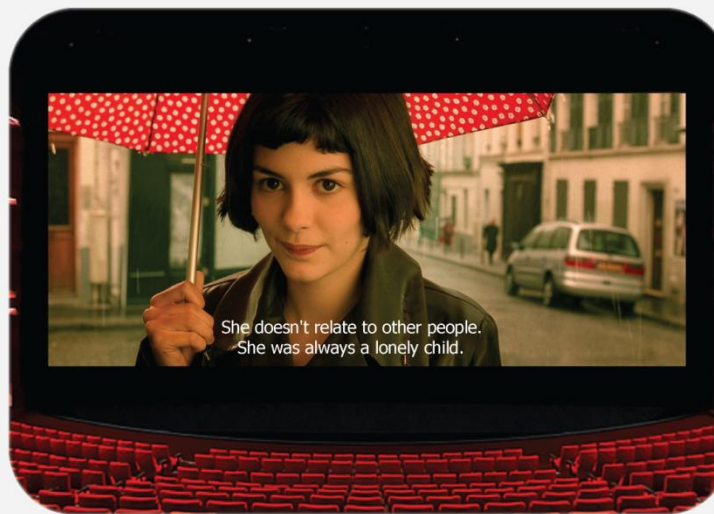
After a few moments our user realises that he does not want to watch the movie with zoomed in subtitles, but would prefer watching it differently. Therefore, he presses the glasses OK button once and the **Disable Subtitles** button appears on screen. He presses OK again and disables the magnified text.



With the subtitles now being switched off, the glasses automatically activate Cinema mode's secondary feature, its zooming option, which offers the user the choice to zoom in or out on the screen when and as he pleases. Before the user can do that though, the projected screen has to first be detected. Therefore, a red dotted shape takes the form of the screen, surrounding it, and fades out when detection is complete.



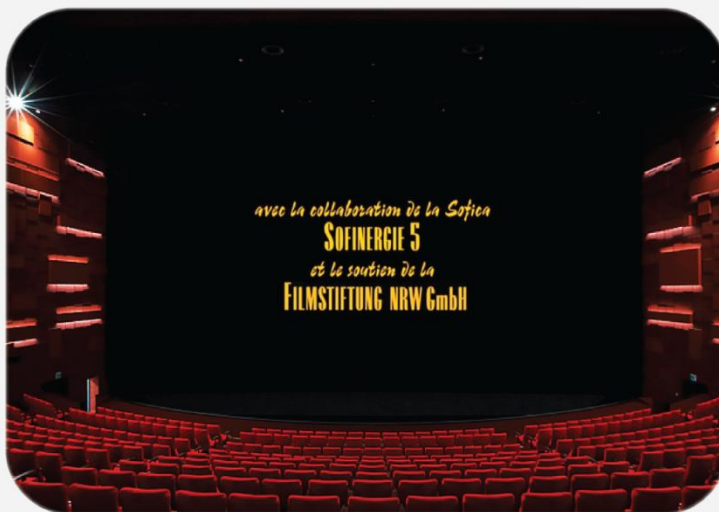
The user can now zoom in and out when and as he pleases. By clicking the glasses OK button the zooming options appear. The options consist of **Zoom In**, **Zoom Out**, and **Re-Enable** Cinema mode's main feature. In this example, the user decides to zoom in on the projected screen.



The screen is now zoomed in according to user preferences. The user is content, and therefore has decided to watch the rest of the movie in this specific zoomed x state. Cinema mode's secondary feature can also be useful for movies that do not have subtitles, though in this example, that is not the case.



The movie has ended and our user is not interested in the end credits. Therefore, he taps the glasses OK button to activate the mode's available options, and then while the **Zoom Out** button is highlighted, clicks OK again enabling it, tapping repeatedly as many times as he wishes, to zoom out accordingly.



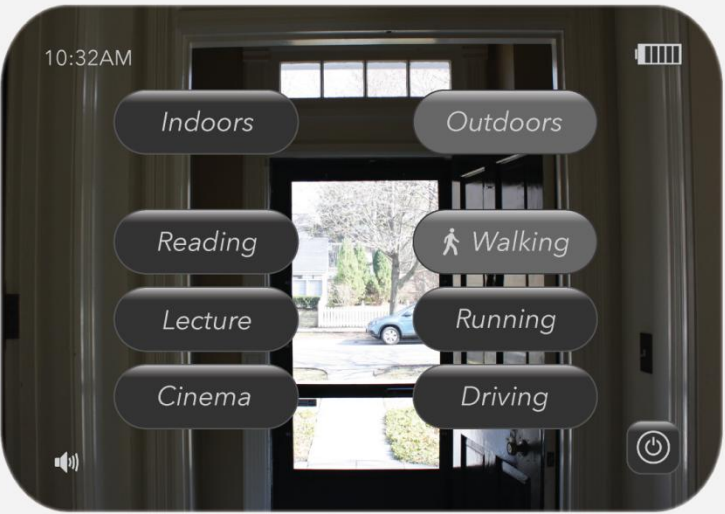
The user has now stopped tapping zoom out, the optional buttons have faded out, since no longer used and the viewer is satisfied with the screen's depicted visual distance. Therefore, he continues looking at the screen for the film's remaining run-time minutes. The movie ends and the user returns to the menu.



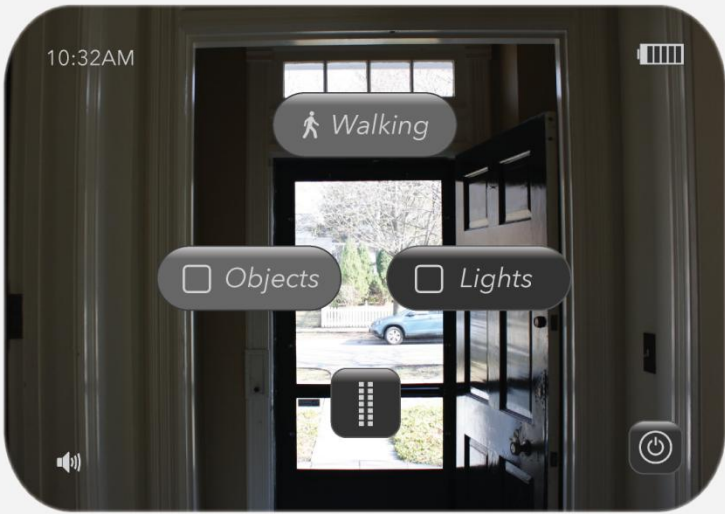
The movie has ended and our user has exited Cinema mode, returning to the device's main menu, by constantly pressing the glasses Exit button.



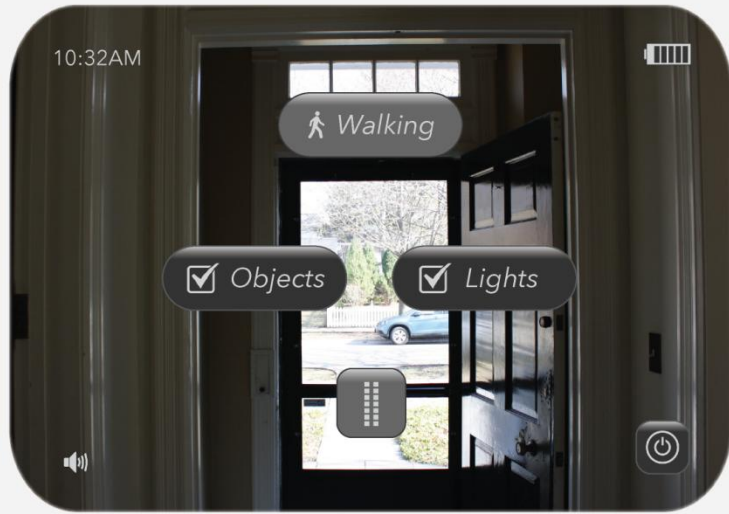
Our user decides to not turn off the device, and by clicking the glasses right arrow switches to Walking mode in order to head back home.



The user wishes to go to a nearby coffee shop to meet a friend. He opens the device, selects **Features** and from the **Outdoors** section, selects **Walking** mode.



Walking mode lets the user select whether he wants the device to detect **Objects** and / or Traffic Lights (for cars & pedestrians).



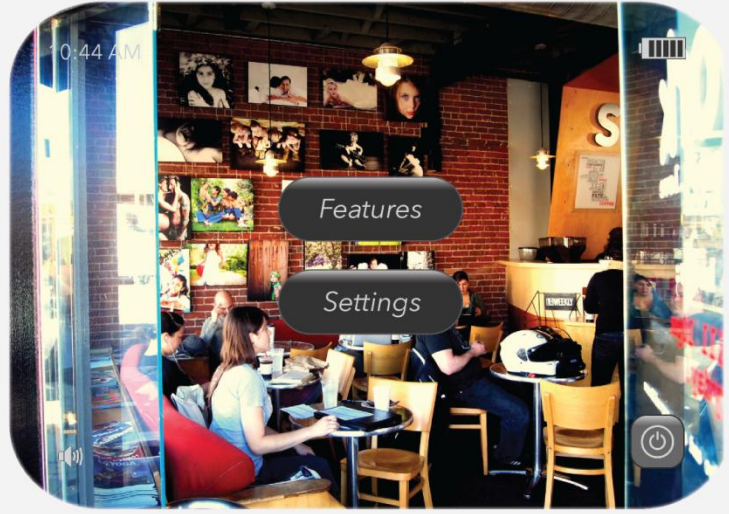
Due to severe eyesight problems the user selects both, needing increased assistance to arrive to his destination safely. Outdoors features have a faster processor than Indoors features, due to more advanced needs, and so that is why Walking mode loads instantly, while *time, battery, sound, and Power Off* fade out.



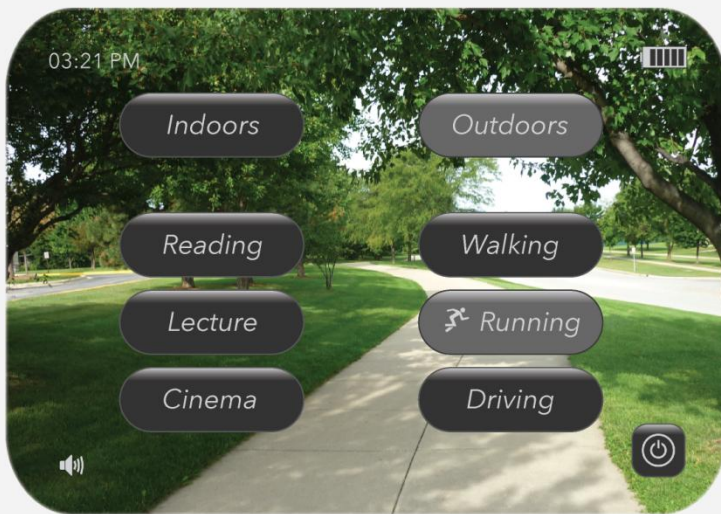
The user has started walking on the street, and as seen in the above slide, people close by to him are detected by the glasses, and are highlighted in a red rectangle which surrounds their figures, so that our user can avoid possible collision with one of them, that might even lead to a potential injury, for both parties.



The coffee shop at which the user is supposed to meet his friend is right across the street. Our user has always had problems distinguishing traffic lights, but with the assistance of the glasses, that create a 3D magnified imaging of the traffic light symbol, the user is able to cross the road successfully.



The user has now arrived at his destination safely and without frustration, and therefore exits Walking mode, returning to the device's main menu by constantly pressing the Exit button. He then turns off the device, since he has no need of it for now.



The user decides to go jogging, starting from the city park and slowly making his way downtown. Therefore, he opens the device, selects **Features** and from the **Outdoors** section, selects **Running** mode.



The Running menu has now appeared in front of the user and gives him the option to select between the highlighting of **Objects** and the **Distance** between him and those objects. He can either select one of these available features or both of them if he pleases, depending on his needs.



Our user selects both **Objects** and **Distance** and presses the glasses OK button enabling the track icon at the bottom, which commences the device's Running mode. The *battery, time, sound and Power Off* option icons and button respectively faded out as soon as Running mode commences.



The user has now started running within the park, heading slowly towards the city centre. The device detects the people running close by to him, surrounding and highlighting them with a red filled rectangle. On top of each person appears the distance between him and the device user, creating a better perception of available space and distance for our user. The pulse of the runner is always also displayed on the top right, as an extra feature.



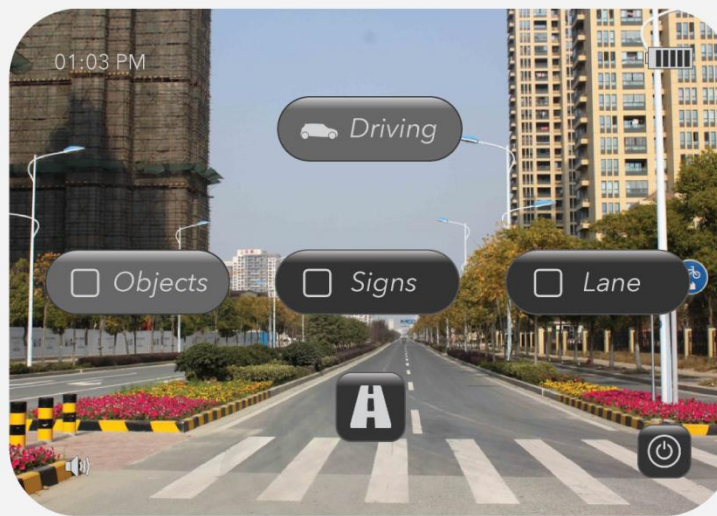
The user continues running and has now almost reached the city centre. The device now detects cars as well as people (either pedestrians or fellow joggers), creating a safe running experience for our user.



Our user has now arrived downtown and has stopped running. Since the device is no longer of use to him he continuously presses on the glasses Exit button and escapes running mode, being directed automatically to the main menu. He then clicks on **Power Off** and switches off the device.



The user has to drive somewhere and so enters his car and turns on the device. Therefore, he opens the device, selects **Features** and from the **Outdoors** section, selects **Driving** mode.



The driving mode menu gives the user the choice to select between the detection of 3 elements. **Objects**, **Signs**, and **Lane**. He can either choose one of them, two of them or all of them, depending on his needs and severity of his eyesight problem.



In our case, the user decides to select all three of them, due to having severe vision problems, that make it almost impossible for him to drive without the glasses assistance. The *battery*, *time*, *sound* and **Power Off** option icons and button respectively faded out as soon as Driving mode commences.



The user has now started driving slowly within the city. The device has been programmed to identify the shape of both vehicles and people and so in the above slide has detected several objects, both pedestrians and cars. It creates a red filled rectangle around the shape of the objects, highlighting them, and subsequently making it easier for the user to identify them and keep a safe distance.



The user has increased speed, driving on the freeway. The device can now detect objects, signs and the lane on which the user is driving on. The nearest objects are highlighted with red. Since our user is driving on the right side of the road the rightmost sign is always the first one which is detected, and magnified on the top right for the user to read through with ease. The lane is highlighted with a light color so that the user can follow it effortlessly.



The user has now successfully arrived at his destination, driving without frustration due to the help of the glasses. Since he no longer needs to make use of the device, he decides to escape driving mode by constantly pressing the glasses Exit button and exiting to the main menu. From there, he clicks **Power Off**.

High fidelity prototype evaluation

Survey

A small scale survey was conducted through e-mail. The participants received an e-mail with all the screenshots of the High-Fidelity prototype along with the questionnaire and a small description of the system. The e-mail that was sent said:

"Please help us complete our survey for a device that our team designed in HCI course.

Answer the questionnaire honestly.

If you can forward this to others as well.

This device is going to be attached on eye-glasses and has various functions.

How to complete the survey:

- 1. read the vision enhancement system pdf*
- 2. the survey questions are in the surv.pdf*
- 3. complete your personal information and answers in the questionnaire excel.*
- 4. send your excel file with your answers back to us*

Thank you

Best Regards"

The first ones to receive the questionnaire were friends and family of the team members but they were also asked to forward it to others as well. Participants were asked to answer it frankly. The survey was conducted to people living in Cyprus and Greece.

The questionnaire that was used was that of System Usability Scale (Brooke, John 1986). The questionnaire that was given to the participants is shown below.

System Usability Scale

© Digital Equipment Corporation, 1986.

	Strongly disagree						Strongly agree
1. I think that I would like to use this system frequently	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	1	2	3	4	5		
2. I found the system unnecessarily complex	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	1	2	3	4	5		
3. I thought the system was easy to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	1	2	3	4	5		
4. I think that I would need the support of a technical person to be able to use this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	1	2	3	4	5		
5. I found the various functions in this system were well integrated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	1	2	3	4	5		
6. I thought there was too much inconsistency in this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	1	2	3	4	5		
7. I would imagine that most people would learn to use this system very quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	1	2	3	4	5		
8. I found the system very cumbersome to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	1	2	3	4	5		
9. I felt very confident using the system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	1	2	3	4	5		
10. I needed to learn a lot of things before I could get going with this system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	1	2	3	4	5		

In order to make the survey as objective as possible the team agreed to the following approach:

- Questionnaires were sent abroad and not within the University.
- Participants were asked to take answers from others as well.

This gave the team a chance to have answers from people that are not only students but they are closer to the general population with various everyday lives and interests.

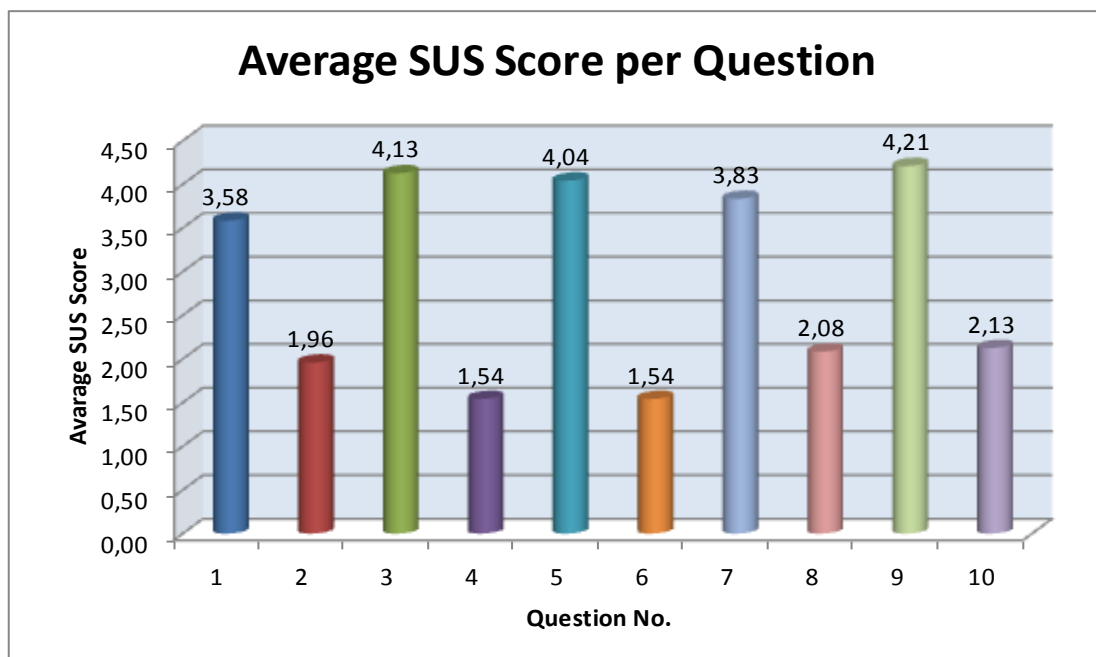
Problems that the team faced during the survey:

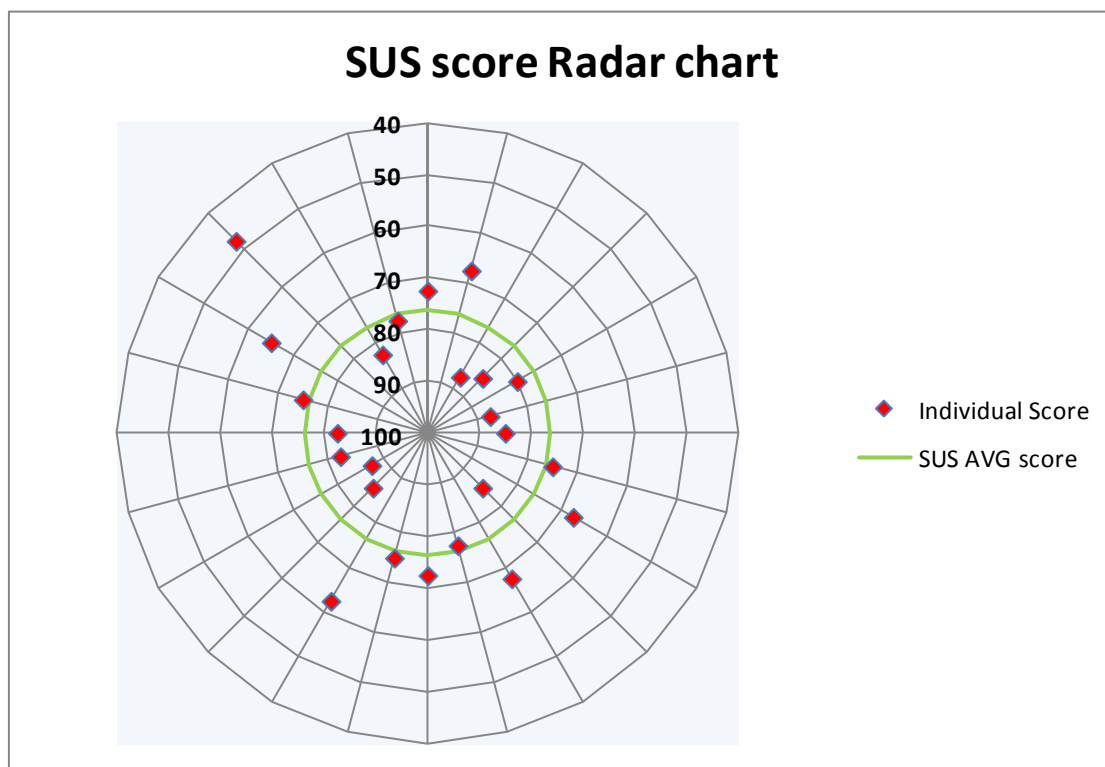
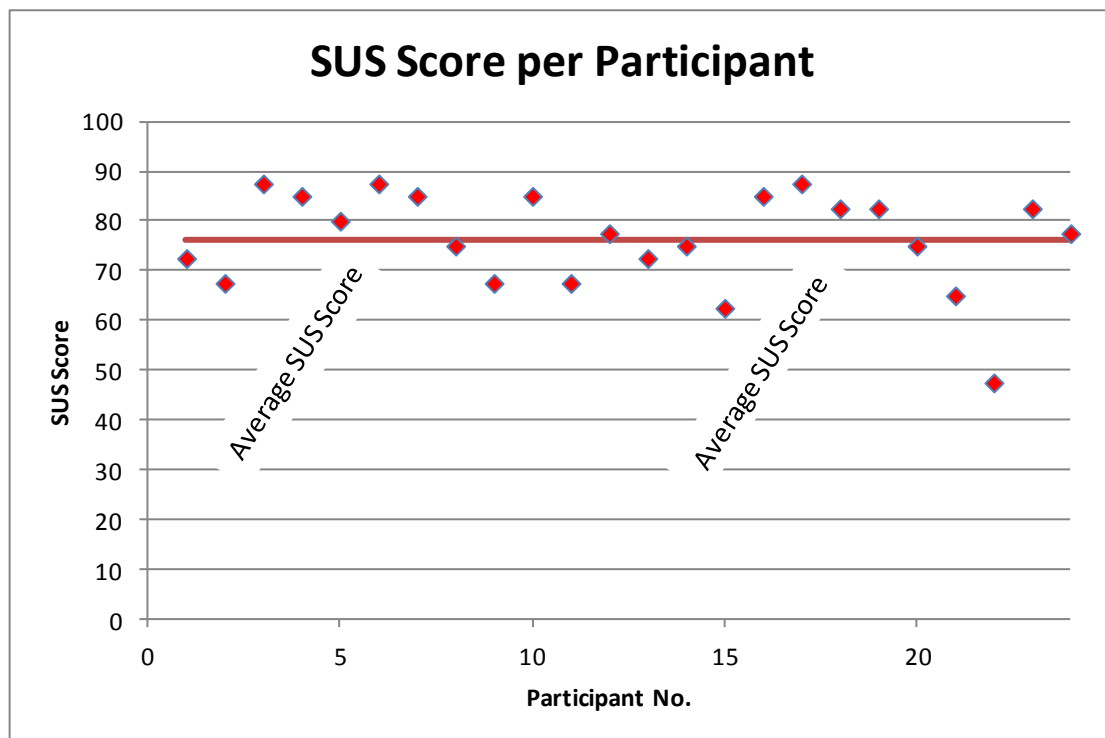
- Participation of older people was scarce.
- There was no actual device to be shown to the participants and similar devices do not exist in the market today. Due to this fact the participant had to imagine what it would be like to use such a device.
- Because the survey started from the team members' friends and family the biased factor is higher rather than faceless/nameless surveys.
- Most participants were around the same age group.

According to Bangor 2009, all systems score a mean score of 69.5 and specifically for hardware systems a mean score of 71.8 and GUI systems score a mean score of 76.2.

The High Fidelity prototype scored a **76.35** on average, on a 24 participants survey. This score puts the system in the third Quartile (bounds 70.5 - 77.8) meaning that it scores above 50% or more of what other systems score.

Age group	20-29	30-39	40-49	50-59	60-69	70-79
Participants	12	8	1	1	1	1





According to Tullis and Stetson (2004) the SUS reaches an accuracy of 90-100% at a sample size of 12 people and reaches an asymptotic. The sample size at our survey was of 24 participant so the result is expected to have a good accuracy.

The team received various comments concerning the device.

Most people found the driving and reading modes the most useful. Some of them asked whether a translation of the subtitles to their mother language is possible.

Seminar and cinema mode was considered as useful by some participants.

Walking and running modes were considered not that useful. The running mode might be used by some users but only for the heart beats per minute information that is displayed.

FURTHER SURVEYS

In case this device moves to the next level of research, surveys should be conducted in order to find out on which age group this device is appealing to. Furthermore, in order to have a good picture of what features people would be interested to be implemented on the device surveys should be carried out by professionals.

Heuristics Evaluation

Evaluation method used: Nielsen's

Heuristics

1. Visibility of system status
2. Match between system & real world
3. User control and freedom
4. Consistency & Standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility & Efficiency of use
8. Minimalistic design
9. Help error recovery
10. Help & Documentation

Evaluation rates:

- 0 – don't agree that this is a usability problem
- 1 – cosmetic problem
- 2 – minor usability problem
- 3 – major usability problem; important to fix
- 4 – usability catastrophe; imperative to fix

	SEVERITY	WAYS TO IMPROVE
Visibility of system status		
The menus are forward. Some may argue that OK button would be preferable instead of icons.	0	Nothing to improve.
Match between system and real world		
In general the user can understand the system. Also it isn't clear how the user will navigate on the system.	1	User manual will be given.
User control and freedom		
The system is straight forward and menu-based.	0	Nothing to improve.
Consistency and standards		
The system is consistent. The only objection being that instead of OK button we have an image but is always in the same place.	1	Improvement should be made only if through survey people feel that it should be changed.
Error prevention		
The system is not prompt to errors but there is no system anyway to evaluate real life errors.	2	Further research.

Recognition rather than recall		
The only thing the user has to type are his information, so that minimizes load on user's memory.	0	No change needed.
Flexibility and efficiency of use		
Because the information displayed is real world image there is no need for the user to adjust brightness, contrast etc. Locks mode while driving to prevent switching to another mode while driving so it is pretty efficient.	0	No change needed.
Aesthetic and minimalistic design		
As an image not a problem.	0	Nothing to change
As a device it is expected to be quite bulky.	3	The most minimalistic components should be used in order to have a smaller device (Further in the Future)
Help error recovery		
When system crashes for a reason the device shuts down.	2	A quick error message should appear on the screen just to inform the user that the system is shutting down.
Help and documentation		
The system is easy to use and menu-based and a user manual will be given.	0	Nothing to change.

Summary and recommendations

Similar systems are only in research phase at present. This fact does not allow the team to compare the approach to solving the addressed problems with the approach other systems have followed. Through the survey the team conducted results show that people felt comfortable using the system and very excited if this system was developed on a next level.

Even though the system is far from being perfect the team tried to approach and solve as many problems as it managed to recognize during the development of first two prototype generations. The fact that the final product is a hardware product is limiting the team's ability to address problems concerning the real life system.

Many more issues should be addressed majorly concerning the modes such a device should implement and what hardware should be used to make all the functions to work. Concerning the hardware that will be used care should be taken as to which of them have been patented and if these components can be used.

The team had clear goals and objectives since the very beginning. Due to the fact that the interests and skills every member brought in the team we managed to be creative and productive.

The major difficulties the team faced was concerning searching for previous implementations.

The team worked on the two prototype generations as follows

Three lo-fi prototypes were designed. Every prototype was developed by a different member of the team. Projects that are closely related to this system are not in production but rather in research stage. In order to have different approaches to the system every member worked individually developing a prototype and the fourth member worked alongside all three lo-fi prototypes. The heuristics evaluation and scenario based evaluation was done by the whole team. Two of the prototypes were designed by hand sketches and one with Microsoft Word. The reason for this was to develop prototypes easily and quickly with just the main functions illustrated in order to get a rough idea of what the system should be able to do and how it would be able to serve its purpose.

The hi-fi prototype was developed by the fourth member of the team based on the conclusions of the evaluation of the lo - fi prototypes. In order to develop the hi-fi prototype in an unbiased way the design was performed by the fourth member of the team with the involvement of the other three members. Adobe Photoshop was used to make this prototype as it was a software the team was accustomed to using. Evaluation was done by the whole team based on heuristics and scenarios from personas

Due to the excellent collaboration of entire team, we believe that this first implementation of the idea can be taken further for studying and evaluation of whether such system would be feasible to go into production.

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